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FINAL SAMPLING AND ANALYSIS PLAN SOLID WASTE MANAGEMENT UNIT 17 (SWMU 17) FLUVIAL DEPOSITS GROUNDWATER SAMPLING SOLID WASTE MANAGEMENT UNIT 22 (SWMU 22) LOESS SOIL SAMPLING MILLINGTON SUPPACT TN

11/1/2013

RESOLUTION CONSULTANTS

FINAL
SAMPLING AND ANALYSIS PLAN

SWMU 17 — FLUVIAL DEPOSITS GROUNDWATER SAMPLING
SWMU 22 — LOESS SOIL SAMPLING
NAVAL SUPPORT ACTIVITY MID-SOUTH
MILLINGTON, TENNESSEE

Version Number: 0

Prepared For:

NAVFAC
Naval Facilities Engineering Command
NAVFAC MIDWEST

Department of the Navy
Naval Facilities Engineering Command Midwest
201 Decatur Avenue, Building IA
Great Lakes, Illinois 60088

Prepared By:

RESOLUTION CONSULTANTS

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Contract Number: N62470-11-D-8013
CTO F27B

November 2013

SAP WORKSHEET #1: TITLE AND APPROVAL PAGE

(UFP-QAPP Manual Section 2.1)

SAMPLING AND ANALYSIS PLAN

SWMU 17 — FLUVIAL DEPOSITS GROUNDWATER
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Project Chemist/QA Officer Date

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Corey Coleman, Resolution Consultants
Task Order Manager Date

Harvey Pokorny, NAVFAC Midwest
Remedial Project Manager Date

EXECUTIVE SUMMARY

This Sampling and Analysis Plan (SAP) constitutes the planning document for groundwater and soil sampling at Solid Waste Management Units (SWMUs) 17 and 22, respectively, at Naval Support Activity (NSA) Mid-South in Millington, Tennessee (Appendix A — Figure 1). Specifically, this SAP outlines the data-collection needs and data quality objectives to assess whether the land-use controls on the two SWMUs may be lifted.

This SAP has been prepared by Resolution Consultants on behalf of the United States Navy, Naval Facilities Engineering Command (NAVFAC) Midwest Division, Comprehensive Long-term Environmental Action Navy Contract N62470-11-D-8013, Contract Task Order F27B, in accordance with the Navy's Uniform Federal Policy SAP policy guidance. A Tier II SAP has been prepared because the work involves minor investigative efforts.

SWMU 17, on the NSA Mid-South Southside, near the west property line (Figure 1), includes (1) an asphalt-covered lot that was formerly used to store landscaping equipment; (2) Building S-940, a vehicle maintenance shop and (3) former underground storage tank (UST) S-9. Installed in 1979 and removed in 1996, UST S-9 is reported to have received used automotive oil and hydraulic fluid generated during automobile maintenance at Building S-9. During the 2001 Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI), a single detection of 1,2-dichloropropane at 28 ug/L was detected in the fluvial deposits aquifer (60'-100' in depth below land surface at site) which exceeds the 5 microgram per liter Maximum Contaminant Level (MCL), resulting in SWMU 17 receiving a groundwater restriction. Given the length of time since the RFI, it is possible that the 1,2-dichloropropane has since attenuated to less than the United States Environmental Protection Agency MCL.

SWMU 22 is the location of four former USTs at the former Boiler Plant (Building S-75). The site contained three field-constructed concrete USTs (No. 1245, 1246, and 1244) used for heating oil, and one steel UST (S-75W) used for diesel fuel. No records are available regarding the closure of the field constructed tanks; however, data associated with the closure of Tank S-75W in 1992 indicated a petroleum release had occurred and residual contamination had migrated beneath Building S-75, which was to be removed following demolition of the boiler plant. Analytical results following the soil removal action associated with the tank excavation are not available to document whether petroleum-impacted soil remains at the site, warranting the proposed data collection outlined in this SAP.

This SAP outlines and/or references the data collection needs, field-sampling protocols, and analytical methods for implementing the work plan and ensuring that the data quality objectives are met for the project.

Table of Contents

Appendices

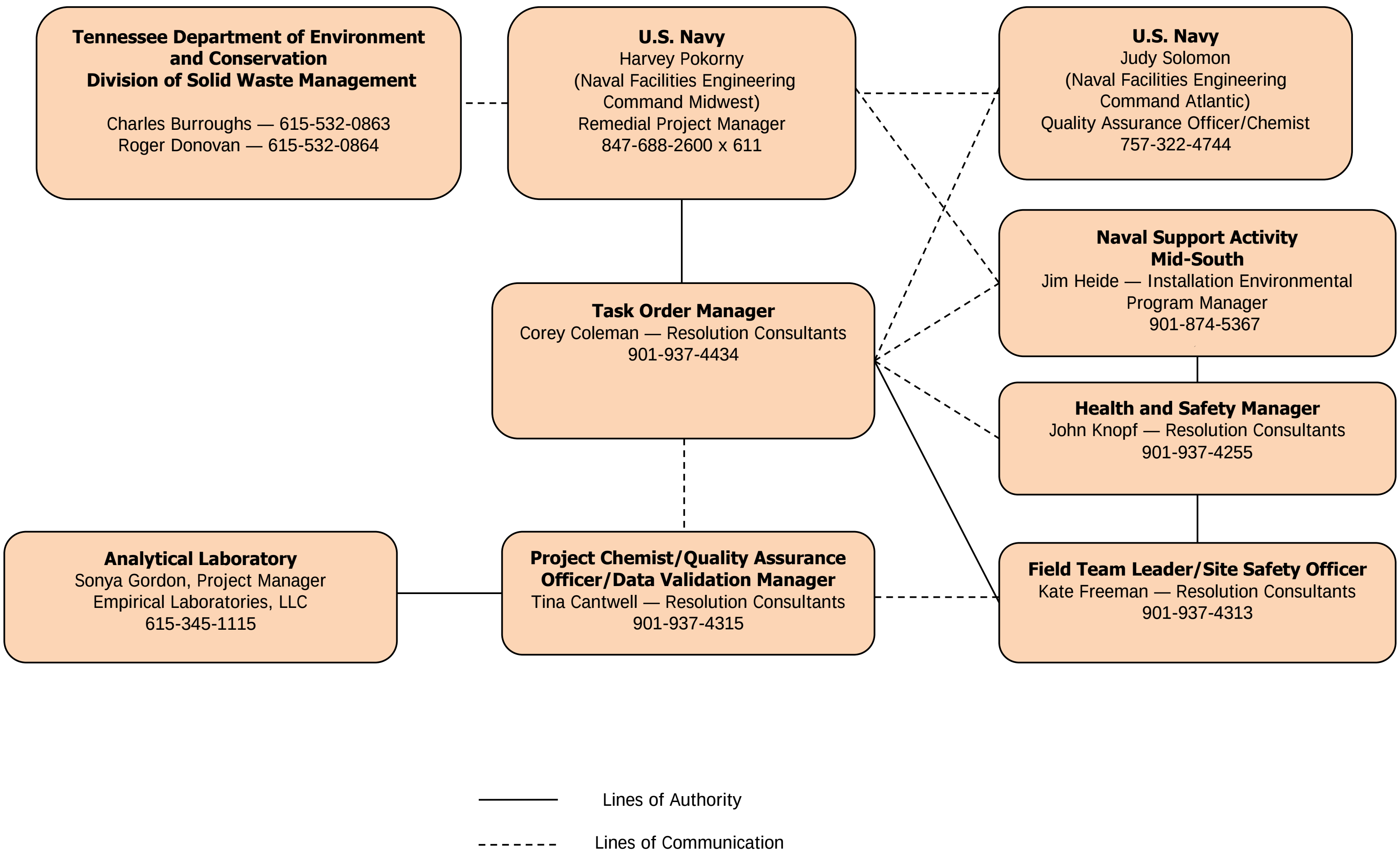
Acronyms and Abbreviations

bgs	Below ground surface
BTEX	Benzene, toluene, ethylbenzene, and xylene
CAS	Chemical abstracts service
COC	Contaminant of concern
CSI	Confirmatory sampling investigation
CTO	Contract task order
DL	Detection limit
DoD	Department of Defense
DPT	Direct push technology
DQO	Data quality objective
DSWM	Division of Solid Waste Management
DVA	Data Validation Assistant
EDD	Electronic data deliverable
EICP	Extracted ion current profile
ELAP	Environmental Laboratory Accreditation Program
eQAPP	Electronic quality assurance project plan
FTL	Field team leader
GC/MS	Gas chromatography/mass spectrometer
HSM	Health and safety manager
ICAL	Initial calibration
IDW	Investigative derived waste
IR	Installation restoration
LCS	Laboratory control sample
LCSD	Laboratory control sample duplicate
LOD	Limit of detection
LOQ	Limit of quantification
LUC	Land use controls
MCL	Maximum contaminant level
MS/MSD	Matrix spike/matrix spike duplicate
µg/L	Micrograms per liter
mg/kg	Milligrams per kilogram
mL	Milliliter
MTBE	Methyl tert-butyl ether
NA	Not applicable
NAVFAC	Naval Facilities Engineering Command
NFA	No further action
NIRIS	Naval Installation Restoration Information Solution
NSA	Naval Support Activity

PAL	Project action level
PDF	Portable document format
PID	Photoionization detector
PM	Project manager
QA	Quality assurance
QAO	Quality assurance officer
QAPP	Quality assurance project plan
QC	Quality control
QSM	Quality Systems Manual
%R	Percent recovery
RCRA	Resource Conservation and Recovery Act
RFA	RCRA facility assessment
RFI	RCRA facility investigation
RPD	Relative percent difference
RPM	Remedial project manager
SAP	Sampling and analysis plan
SOP	Standard operating procedure
SSO	Site safety officer
SWMU	Solid waste management unit
TBD	To be determined
TDEC	Tennessee Department of Environment and Conservation
TOM	Task order manager
UFP	Uniform Federal Policy
U.S. EPA	United States Environmental Protection Agency
USGS	United States Geologic Survey
UST	Underground storage tank
VCA	Voluntary corrective action
VOC	Volatile organic compounds

SAP WORKSHEET #5: PROJECT ORGANIZATIONAL CHART

(UFP-QAPP Manual Section 2.4.1)



SAP WORKSHEET #6: COMMUNICATION PATHWAYS

(UFP-QAPP Manual Section 2.4.2)

The communication pathways for the SAP are shown below.

Communication Pathways				
Communication Drivers	**Responsible Entity**	**Name**	**Phone Number**	**Procedure (Timing, Pathway To/From, etc.)**
Regulatory Agency Interface	Navy RPM	Harvey Pokorny	847-688-2600 x 611	The Navy RPM informs regulatory agency of work progress on a periodic basis.
Progress Reports	Resolution Consultants FTL Resolution Consultants TOM Navy RPM	Kate Freeman Corey Coleman Harvey Pokorny	901-937-4313 901-937-4434 847-688-2600 x 611	FTL verbally informs the TOM on a daily basis — field updates. TOM provides a weekly update to the RPM either by phone message and/or e-mail each Friday afternoon field activities are taking place.
Gaining Site Access	Resolution Consultants FTL Installation Environmental Program Manager	Kate Freeman Jim Heide	901-937-4313 901-874-5367	Follow instructions provided on Standard Operating Procedure SOP-MS Access, provided in Appendix C. For visitors' passes, Form 5530 must be submitted 14 days prior to arrival for approval.
Obtaining Utility Clearances for Intrusive Activities	Resolution Consultants FTL NSA Mid-South Acting IR Site Manager	Kate Freeman Debbie Zanot	901-937-4313 901-874-5368	The Resolution Consultants FTL will coordinate verbally or via e-mail with NSA Mid-South point of contact at least 14 days in advance of site access to initiate the utility clearance process for all intrusive sampling locations.
Stop Work due to Safety Issues	Resolution Consultants FTL/SSO Resolution Consultants TOM Resolution Consultants HSM NSA Mid-South Acting IR Site Manager	Kate Freeman Corey Coleman John Knopf Debbie Zanot	901-937-4313 901-937-4434 901-937-4255 901-874-5317	Any field team member who observes an unsafe situation has the authority to stop work. The responsible party verbally informs the TOM and subcontractor within 1 hour of recommendation to stop work and within 24 hours of recommendation to restart work. Responsible party follows verbal notification with an e-mail to the Project Team within 24 hours. If a subcontractor is the responsible party, the subcontractor PM must verbally inform Resolution Consultants SSO within 15 minutes and the Resolution Consultants SSO will then follow the procedure listed above.
SAP Changes before Field/Laboratory work	Resolution Consultants TOM Navy RPM	Corey Coleman Harvey Pokorny	901-937-4434 847-688-2600 x 611	Any change of the approved SAP will be made only upon authorization of the Navy RPM and regulatory agencies. The Resolution Consultants TOM is responsible for initiating any SAP change requests via the communication channels described for the Navy and regulatory agencies.
SAP Changes in the Field	Resolution Consultants FTL/SSO Resolution Consultants TOM Navy RPM	Kate Freeman Corey Coleman Harvey Pokorny	901-937-4313 901-937-4434 847-688-2600 x 611	FTL informs TOM verbally within same day; TOM informs Navy RPM via e-mail within 24 hours; TOM sends a concurrence letter to RPM, if warranted, within 7 calendar days and RPM signs the letter within 5 business days of receipt. Scope change is to be implemented before work is executed. Document the change on a field task modification request form (within 2 business days) or SAP amendment (within timeframe agreed to by Project Team).

Communication Pathways				
Communication Drivers	**Responsible Entity**	**Name**	**Phone Number**	**Procedure (Timing, Pathway To/From, etc.)**
Field Corrective Actions	Resolution Consultants FTL/SSO Resolution Consultants TOM Navy RPM	Kate Freeman Corey Coleman Harvey Pokorny	901-937-4313 901-937-4434 847-688-2600 x 611	FTL informs TOM verbally within same day; TOM informs Navy RPM via e-mail within 24 hours that corrective actions have been implemented. Corrective actions will be documented in weekly progress reports. Navy RPM will notify TDEC of any significant corrective actions taken.
Recommendations to stop work and initiate work upon corrective action	Resolution Consultants FTL/SSO Resolution Consultants TOM Resolution Consultants QAO Navy RPM	Kate Freeman Corey Coleman Tina Cantwell Harvey Pokorny	901-937-4313 901-937-4434 901-937-4315 847-688-2600 x 611	Responsible party verbally informs the TOM, FTL, and subcontractors within 1 hour of recommendation to stop work and within 24 hours of recommendation to restart work. Responsible party follows verbal notification with an e-mail to the Project Team within 24 hours.
Sample Receipt Variances	Empirical Laboratories PM Resolution Consultants FTL Resolution Consultants TOM	Sonya Gordon Kate Freeman Corey Coleman	615-345-1115 901-937-4313 901-937-4434	The Laboratory PM will notify (verbally or via e-mail) the Resolution Consultants FTL immediately upon receipt of any chain of custody/sample variances for clarification or direction from the Resolution Consultants FTL. The Resolution Consultants FTL will notify (verbally or via e-mail) the Resolution Consultants TOM within 1 business day, if corrective action is required. The Resolution Consultants TOM will assess whether corrective action is required and communicate the decision (verbally or via e-mail) to the laboratory and FTL within 1 business day.
Analytical Corrective Actions	Empirical Laboratories PM Resolution Consultants Project Chemist	Sonya Gordon Tina Cantwell	615-345-1115 901-937-4315	The laboratory shall notify the Resolution Consultants chemist of any analytical data anomaly within 1 business day of discovery. After the laboratory receives guidance from the Resolution Consultants chemist, the laboratory shall initiate any corrective action to prevent further anomalies.

Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathway To/From, etc.)
Analytical Data Quality Issues	Empirical Laboratories PM Resolution Consultants Project Chemist Resolution Consultants TOM Navy RPM	Sonya Gordon Tina Cantwell Corey Coleman Harvey Pokorny	615-345-1115 901-937-4315 901-937-4434 847-688-2600 x 611	The laboratory PM notifies (verbally or via e-mail) the Resolution Consultants chemist within 1 business day of when an issue related to laboratory data is discovered. Resolution Consultants chemist notifies Resolution Consultants TOM within 1 business day. Resolution Consultants chemist notifies the Resolution Consultants TOM verbally or via e-mail within 48 hours of validation completion that a non-routine and significant laboratory quality deficiency has been detected that could affect this project and/or other projects. Resolution Consultants TOM verbally advises the Navy RPM within 24 hours of notification from the project chemist. The Navy RPM takes corrective action that is appropriate for the identified deficiency. The Navy RPM may, at his discretion, contact the Navy QAO/Chemist for assistance in problem resolution. If there are significant data quality or non-useable data issues the Navy QAO/Chemist will be contacted to ensure the issues do not have the potential to impact other Navy projects.
Reporting Data Validation Issues/Data Validation Corrective Actions	Resolution Consultants Project Chemist Resolution Consultants TOM	Tina Cantwell Corey Coleman	901-937-4315 901-937-4434	The Resolution Consultants project chemist/data validator, performing validation as specified in Worksheets #34, #35, and #36, will contact the laboratory as soon as possible if issues are found that require corrective action. If the Resolution Consultants project chemist/data validator identifies non-usable data that require corrective action, the Resolution Consultants TOM will coordinate with the project chemist to take corrective action appropriate for the identified deficiency to ensure the project objectives are met. Corrective action may include resampling and/or reanalyzing the affected samples, as determined by the TOM.

Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathway To/From, etc.)
Notification of Non-Usable Data	Empirical Laboratories PM Resolution Consultants Project Chemist Resolution Consultants TOM Navy RPM TDEC RPM	Sonya Gordon Tina Cantwell Corey Coleman Harvey Pokorny Roger Donovan	615-345-1115 901-937-4315 901-937-4434 847-688-2600 x 611 615-532-0864	If the laboratory determines that any data they have generated is non-usable, the Laboratory PM will notify (verbally or via e-mail) the Resolution Consultants project chemist within 1 business day of when the issue is discovered. The Resolution Consultants project chemist will notify (verbally or via e-mail) the Resolution Consultants TOM within 1 business day of the need for corrective action, if the non-usable data is a significant issue (i.e., critical sample data). Corrective action may include resampling and/or reanalyzing the affected samples. If the Resolution Consultants project chemist or data validator identifies non-usable data during the data validation process, the TOM will be notified verbally or via e-mail within 48 hours of validation completion that a non-routine and significant laboratory quality deficiency has resulted in non-usable data. The Resolution Consultants TOM will take corrective action appropriate for the identified deficiency to ensure the project objectives are met. The Resolution Consultants TOM will notify (verbally or via e-mail) the Navy RPM of any problems with the laboratory or analysis that could significantly affect the usability of the data or project failures that impact the ability to complete the scope of work. The Navy RPM may, at his discretion, contact the Navy project chemist for assistance in problem resolution. Such notification will be made within 1 business day of when the issue is discovered. The Navy RPM will notify TDEC when any significant corrective action is taken.

Notes:

RPM = Remedial Project Manager
TOM = Task Order Manager
IR = Installation Restoration
HSM = Health and Safety Manager
TDEC = Tennessee Department of Environment and Conservation
PM = Project Manager
FTL = Field Team Leader
NSA = Naval Support Activity
SSO = Site Safety Officer
SAP = Sampling and Analysis Plan
QAO = Quality Assurance Officer

SAP WORKSHEET #9: PROJECT PLANNING SESSION PARTICIPANTS SHEET

(UFP-QAPP Manual Section 2.5.1)

Project Name: NSA Mid-South
Project Dates of Sampling: Field Activities for 2013
Site Name: SWMUs 17 and 22
Site Location: NSA Mid-South; Millington, Tennessee
Date of Session: March 6, 2013 Base Cleanup Team Meeting
Scoping Session Purpose: Discuss data gaps for lifting the land-use controls at SWMUs 17 and 22.

Name	Title	Affiliation	Phone #	E-mail Address
Roger Donovan	Remedial Project Manager	TDEC DSWM	615-532-0864	roger.donovan@tn.gov
Charles Burroughs	Head of DSWM	TDEC DSWM	615-532-0863	charles.burroughs@tn.gov
Jim Heide	Head of Public Works/Environmental	NSA Mid-South	901-874-5467	jim.heide@navy.mil
Jack Carmichael	Technical Specialist	USGS	615-837-4704	jkcarmic@usgs.gov
Harvey Pokorny	Remedial Project Manager	NAVFAC Midwest	847-688-2600 x 611	harvey.pokorny@navy.mil
Howard Hickey	Co-Remedial Project Manager	NAVFAC Midwest	847-688-5999 x243	howard.hickey@navy.mil
Scott Powell	Senior Project Manager	Lee & Ryan	248-909-7290	spowell@leeandryan.com
Ben Brantley	Task Order Manager	Resolution Consultants	901-937-4222	bbrantley@ensafe.com
Corey Coleman	Task Order Manager	Resolution Consultants	901-937-4434	ccoleman@ensafe.com
Kate Freeman	Field Team Leader	Resolution Consultants	901-937-4313	kfreeman@ensafe.com

Notes:
NSA = Naval Support Activity
SWMU = Solid Waste Management Unit
TDEC DSWM = Tennessee Department of Environment and Conservation — Division of Solid Waste Management
USGS = United States Geological Survey
NAVFAC Midwest = Department of the Navy, Naval Facilities Engineering Command, Midwest

Comments: SWMUs 17 and 22 are listed in the Resource Conservation and Recovery Act (RCRA) Permit for Naval Support Activity (NSA) Mid-South as requiring a Corrective Measures Study (CMS), to address potential soil and groundwater concerns. This study will determine if the sites qualify for "no further action" or a final remedy. Ben Brantley presented the Solid Waste Management Unit (SWMU) 22 history and a figure showing the locations where soil data was needed to verify whether the contaminated soil associated with former waste oil Tank S-75W, located adjacent to the boiler plant, was removed during the building's demolition. An extensive search by the Navy and Resolution Consultants failed to locate documentation that building demolition contractor

(U.S. Environmental) conducted a soil removal action during demolition activities, leaving a data gap associated with the former tank.

SWMU 17 (Tank S-9 Waste Oil Underground Storage Tank [UST]) — Soil and groundwater data from a Voluntary Corrective Action (VCA) indicated a single detection of 1,2-dichloropropane at a concentration of 28 ug/L at a depth of about 50 feet below ground surface (bgs) — exceeding the 5 µg/L United States Environmental Protection Agency (U.S. EPA) maximum contaminant level (MCL). Given that the VCA data was conducted in 2000, the Navy decided to reevaluate the site and verify whether 1,2-dichloropropane remains at concentrations exceeding the MCL. If the newly collected data indicate concentrations have dropped to less than the MCL, the Navy will adding the SWMU to the list of SWMUs requiring no further action under (NFA) under the corrective action conditions of the permit.

Consensus Decisions: The soil and groundwater sampling design presented in Worksheet #17 was discussed by the Project Team members.

Action Item: Prepare a Tier II Sampling and Analysis Plan (SAP) for regulatory approval with the soil and groundwater sampling design presented at the March 2013 base clean-up team meeting.

SAP WORKSHEET #10: CONCEPTUAL SITE MODEL

(UFP-QAPP Manual Section 2.5.2 — Worksheet #10)

This SAP is for the sampling of groundwater at SWMU 17 and soil at SWMU 22. This sampling will be conducted for the purpose of assessing whether "no further action" (NFA) may be sought for each SWMU.

Information related to site history, regional site geology, contaminant sources, exposure pathways, and the basis for the conceptual site model development are described below. This SAP worksheet incorporates discussions with Project Team members and information from the following documents:

- *RCRA Facility Investigation Report, Assembly F SWMUs — 17, 19, 20, 22, 39 and 63, Millington, Tennessee, Revision 1* (EnSafe 2000)
- *Voluntary Corrective Action Report SWMU 17* (EnSafe 2001)
- *Voluntary Corrective Action Report SWMU 22* (EnSafe 2001)
- *Statement of Basis SWMU 17* (EnSafe 2005)
- *Statement of Basis SWMU 22* (EnSafe 2005)

All figures referenced in the SAP are included in Appendix A.

10.1 Background/Site History

The Base was acquired by the Navy in 1942. From the 1940s to 1997, its primary mission was to serve as the host command for the Naval Air Technical Training Center. Operational closure was completed in October 1997 as a result of the Base Realignment and Closure Act of 1990. In 1999, the 551-acre airfield parcel was transferred to the Millington Municipal Airport Authority, while a 1,311-acre non-airfield parcel was transferred to the City of Millington (the transferred parcel is shown on Figure 1 in Appendix A). The non-transferred portion of the Northside was realigned with the Southside as Naval Support Activity Mid-South.

10.1.1 SWMU 17

SWMU 17 (Figure 2) is approximately 100 feet north of Ticonderoga Street on the NSA Mid-South Southside. Topography at the site slopes to the south and west. SWMU 17 consists of (1) an asphalt-covered lot that was formerly used to store landscaping equipment;

(2) Building S-9, a current building used as a vehicle maintenance shop; (3) a former building used as a maintenance shop and office space by a landscaping contractor, and (4) former UST S-9. Installed in 1979 and removed in 1996, UST S-9 is reported to have received used automotive oil and hydraulic fluid generated during automobile maintenance at the former Building S-9.

The site was initially investigated in 1990 as part of the RCRA Facility Assessment (RFA) (ERC/EDGe 1990). As a result of former operations at the site, the UST at Building S-9 was designated as SWMU 17, warranting further evaluation to determine if a release from the tank had occurred.

In addition to the 1990 RFA, previous investigations at SWMU 17 include a VCA, conducted by Koester Environmental Services, Inc. in 1996 to remove the UST and associated soil (Koester 1996). Soil and groundwater data from the removal action indicated that a prior release from the UST had occurred. Therefore, to determine the nature and extent of contaminants related to the UST and its piping connections, a Confirmatory Sampling Investigation (CSI) was conducted in 1998. The results of the SWMU 17 CSI are reported in the Assembly F RCRA Facility Investigation (RFI) report (EnSafe 2000). From the findings of the CSI, a recommendation was made for additional soil removal and a second VCA was conducted in June 2000 to remove the residual petroleum-contaminated soil (EnSafe 2001).

During the 2000 RFI, a single detection of 1,2-dichloropropane of 28 micrograms per liter (ug/L) was detected in the groundwater in the fluvial deposits aquifer, which exceeds the 5 ug/L U.S. EPA Maximum Contaminant Level (MCL) for this compound, resulting in the site receiving a groundwater restriction. Given the length of time since the RFI, it is possible that the 1,2-dichloropropane has since attenuated to less than the U.S. EPA MCL; however, groundwater monitoring data have not been collected at the site since this time.

10.1.2 SWMU 22

SWMU 22 (Figure 2) is the location of four former USTs at the former Boiler Plant (Building S-75). The site contained three field-constructed concrete USTs (No. 1245, 1246, and 1244), used for heating oil, and one steel (S-75W) UST, used for diesel fuel. The three heating oil tanks were located on the west portion of the SWMU, while the diesel fuel tank was located near the southwest corner of the former building S-75. Data associated with the 1992 closure of Tank S-75W indicated a petroleum release had occurred and residual contamination had migrated beneath the Building S-75. This tank, along with the three others, was assessed to determine the soil and groundwater impacts and appropriate corrective measures. As a result of the petroleum-related impacts associated with the former Tank S-75W and the lack of closure documentation associated with Tanks 1244, 1245, and 1246, SWMU 22 was designated as a site warranting further evaluation to determine whether additional releases of hazardous constituents had occurred.

A subsequent CSI was completed in 1997 and, based on the investigation findings; a more comprehensive RFI (EnSafe 2000) was completed. Analytical results from these investigations resulted in the RFI recommendation to remove petroleum-contaminated soil. Accessible soil was removed through a VCA (EnSafe 2001), while removal of contamination that extended beneath the building was deferred pending the planned demolition of the building. The building has since been demolished. Clean closure was achieved for the three heating oil tanks. U.S. Environmental removed the tanks in 2000 and was reportedly contracted to complete the soil removal concurrently; however no documentation exists as to whether the soil removal action was completed for the diesel tank, S-75W.

10.2 Conceptual Site Model

The conceptual site models for each site are shown on Figures 3A (SWMU 17) and 3B (SWMU 22), included in Appendix A.

10.2.1 Nature and Extent of Contamination

The nature and extent of contamination has been determined, in part, at both SWMUs during prior investigations and removal actions:

- At SWMU 17, impacts are limited to the presence of 1,2-dichloropropane contamination in the fluvial deposits aquifer, with the depth of contamination at approximately 50 to 60 feet bgs.

- At SWMU 22, impacts are limited to petroleum contamination in the loess soils (10 to 20 feet bgs) in the area of former diesel tank S-75W.

10.2.2 Site Geology/Hydrogeology

SWMU 17

The conceptual model figure for SWMU 17 is shown on Figure 3A in Appendix A. The impacted fluvial deposits aquifer is of Pliocene to Pleistocene age, and consists of inter-bedded sand and gravel with lesser amounts of silt and clay. At one time, many shallow domestic wells were completed in the aquifer in the Memphis area, but have since been abandoned as a result of municipal water supplies from the deeper Memphis and Fort Pillow aquifers being introduced in the area in the early to mid-1900's. At NSA Mid-South, the fluvial deposits aquifer is overlain by a layer of loess or alluviated loess made up primarily of clay and silt which ranges between 25 and 45 feet thick at NSA Mid-South. Because of its lower permeability relative to the fluvial deposits, the loess serves as an upper confining unit to the underlying fluvial deposits aquifer.

The basal part of the fluvial deposits aquifer, which ranges from about 75 to 90 feet deep at the site, generally contains an increase in gravel content and commonly is the more hydraulically conductive zone within the aquifer. The aquifer is underlain by interbedded sand, clay, silt, and lignite of the Cockfield Formation, which comprise the uppermost part of the Jackson-upper Claiborne confining unit, and which separates the fluvial aquifer from the Memphis aquifer, the primary source of municipal water in the Memphis area today.

SWMU 22

The conceptual model for SWMU 22 is shown in Figure 3B in Appendix A. The site is underlain by loess, which ranges between 25 and 45 feet thick. Commonly there is a perched groundwater zone in the loess, but given its low yield and poor water quality, it is not considered a viable water source. Former investigations at NSA Mid-South have shown that the relatively low permeability loess typically retards the vertical migration of petroleum releases to deeper than 20 to 30 feet bgs, and generally protects the fluvial deposits aquifer from significant contamination by leaking petroleum USTs. While no current receptors exist at the site, remnant, unaddressed petroleum-impacted soil may pose a risk to future construction workers who might contact sub-surface soil. Additionally, petroleum-impacted soil may pose an indoor air quality risk to occupants of buildings that might be constructed at the site in the future.

10.2.3 Contaminant Migration

The goal of the investigation is to determine if there is 1,2-dichloropropane contamination present in the fluvial deposits aquifer at SWMU 17, and petroleum contamination in the loess soil in the area of the former S-75W tank at SWMU 22. No information is available at present on contaminant migration from either SWMU.

10.2.4 Exposure Pathways

At SWMU 17, groundwater consumption is the primary risk driver; the concentration of the single detection of 1,2-dichloropropane (28 ug/L) exceeded the 5 ug/L MCL in past sampling conducted during the RFI (EnSafe, 2000). However, the fluvial deposits aquifer is not used as a potable water source because Shelby County ordinances prohibit its use for drinking; since municipal supplies from the underlying Memphis aquifer are available in the area. Hence, human exposure pathways are prevented through the local ordinances. For the SAP, sampling will be performed to determine whether a land use control (LUC) would be required on the parcel or if the 1,2-dichloropropane has naturally attenuated to less than the MCL. Given the depth of the 1,2-dichloropropane (estimated between 50 to 60 feet) and the thickness of the clay/silt deposits (25 to 45 feet) that overlie the fluvial aquifer, there is minimal risk associated with other potential pathways (i.e., vapor intrusion or future construction worker). Therefore, proposed investigation activities focus on verifying the presence and defining current concentrations of 1,2-dichloropropane in groundwater.

At SWMU 22, petroleum contamination in the loess is driving the investigation. Conclusions regarding potential site risk under exposure scenarios for construction workers, future site workers, trespassers, and future site residents were assessed in the Statement of Basis for SWMU 22 for soil and groundwater (EnSafe, 2005). Soil exposure pathways have been identified for the receptors listed; however, no chemicals of concern were identified in groundwater for hypothetical residential or industrial reuse scenarios. Therefore, proposed investigation activities focus on refining site soil data.

SAP WORKSHEET #11: DATA QUALITY OBJECTIVES/SYSTEMATIC PLANNING PROCESS STATEMENTS

(UFP-QAPP Manual Section 2.6.1)

The data quality objectives (DQOs) for these investigations were developed based on the *Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA QA/G-4) (U.S. EPA 2006) and are presented below.

11.1 Problem Statement

Historical information regarding operations and information from previous studies indicate that groundwater at SWMU 17 and soil at SWMU 22 were impacted by former operations. Additional sampling is required to determine whether NFA determinations are attainable or if additional remedial actions are necessary.

11.2 Identify the Goals of the Study

Groundwater samples will be collected from SWMU 17 to determine the impact of 1,2-dichloropropane in fluvial deposits aquifer groundwater. Soil samples will be collected at SWMU 22 to determine the impact of petroleum contamination in the loess soils. Sufficient sampling will be conducted to ensure a final remedy determination is possible.

11.3 Inputs to Problem Resolution

The inputs needed to resolve the project problem statement identified in Section 11.1 include field observations and measurements, analytical data, site feature locations, and project action levels (PALs) as described below. Specific informational inputs to serve as the basis for decisions during the execution of this project include the following:

- Sample Locations: Sample locations will be biased to address the areas of suspected contamination. For SWMU 17, temporary groundwater monitoring wells will be set in the vicinity of the former UST, while for SWMU 22, soil samples will be taken from the location of the former diesel tank, S-75W. Proposed sampling locations for each SWMU are included in Figures 4 and 5.

- Geologic/Hydrologic Information: Site geology and hydrogeology will be updated with observations made during installation of temporary monitoring wells and soil borings using a direct push technology (DPT) rig. Routine data will be collected from groundwater purging as part of SWMU 17 monitoring well sampling.

- Sample Location Data: Sample locations (horizontal coordinates and vertical depths) will be measured for use in mapping each location so that data can be analyzed and presented in a spatial context. Horizontal coordinates of each sample location will be determined by Global Positioning System, which will allow for future reacquisition of the locations if further investigation or remedial action is necessary.

- Chemical Data: Groundwater samples will be collected from three temporary monitoring wells to be installed at SWMU 17 during a one-time sampling event and analyzed for 1,2-dichloropropane (SW-846 Method 8260B); results will be compared to the U.S. EPA MCL. The methods that are necessary for collection and analysis of the samples at SWMU 17 are provided in Worksheet #17. Because the former S-75W UST was used for diesel fuel storage, soil data from SWMU 22 will be collected for selected volatile organic compounds (benzene, toluene, ethylbenzene, and xylene [BTEX], naphthalene, and methyl tert-butyl ether [MTBE]) in accordance with the TDEC Risk Based Clean-up Levels for USTs (TDEC 2007); analyses will be performed using SW-846 Method 8260B. The concentrations of any detected target analytes will be compared to their respective PALs, and the results will support the decision making process for future actions. Soil samples will be collected from a one-time sub-surface soil sampling event at SWMU 22. The methods that are necessary for collection and analysis of the samples at SWMU 22 are provided in Worksheet #17.

- Project Screening Limits: PALs for groundwater at NSA Mid-South are U.S. EPA MCLs, as decided on by the Project Team. PALs for soils during this investigation are the TDEC Risk Based Clean-up Levels for USTs (TDEC 2007). The project requires laboratory data that can be compared to PALs so that appropriate decisions can be made. Laboratory quantitation limits must be low enough to measure constituents of potential concern with concentrations equal to or below the PALs. PALs are identified in Worksheet #15.

- Field Screening: A photoionization detector (PID) will be used to measure organic vapors during soil sampling activities. Field screening data will assist with characterization and the selection of sample depth intervals. Results of field screening are not considered definitive and thus will only be be used qualitatively to aid in decision making in the field.

11.4 Define the Study Boundaries

Spatial Boundaries: The SWMU 17 boundary is a 0.27-acre rectangular area located south of the current maintenance building shown on Figure 4. Vertically, the SWMU extends to groundwater in the fluvial deposits aquifer, an area defined by its upper contact with the surficial loess/silt layer (25 to 40 feet bgs) and its lower contact with the Cockfield Formation, a confining unit comprising fine sand, clay, and lignite and ranging between 75 and 120 feet bgs. The investigation will focus on the upper part of the fluvial deposits aquifer, with sampling intervals expected to range in depth between 45 and 55 feet bgs.

SWMU 22 is an approximately 0.6-acre area west of the footprint of the former S-75 building, bounded by the base boundary to the west. The investigation at this SWMU will examine the loess soils in the area of the UST formerly located near the southwest corner of the former S-75, focusing at depths between 10 and 15 feet bgs.

11.5 Analytic Approach

The sampling events will assess the current state of contamination at SWMUs 17 and 22 using biased sampling techniques. Initial determinations on the need for follow-up action will be based on whether analytical data exceed MCLs (SWMU 17) or TDEC Risk based Clean-up Levels for USTs (SWMU 22). The PALs for both media are provided on Worksheet #15. The collected data will be used in the following project decisions:

Decision Rule #1: SWMU 17

If the data indicate that 1,2-dichloropropane is present and in concentrations less than the PAL for groundwater at SWMU 17, recommendations will be made to TDEC for NFA.

Decision Rule #2: SWMU 17

If the data indicate that 1,2-dichloropropane is present and in concentrations greater than the PAL for groundwater, the Project Team will evaluate whether a LUC will be implemented through Interim Corrective Measures.

Decision Rule #3: SWMU 22

If the data indicate that petroleum contaminants are present in soil at SWMU 22 in concentrations less than the PALs for soil at SWMU 22, recommendations will be made to TDEC for NFA.

Decision Rule #4: SWMU 22

If data indicate petroleum contaminants are present in soil in concentrations greater than the PALs, a soil removal work plan will be prepared, outlining appropriate measures which could include (but are not limited to) supplemental delineation and/or corrective measures.

11.6 Performance Criteria

The objective of this section is to complete the following:

- Identify potential sources of study error (i.e., field error, analytical error)
- Establish and identify the methods used to reduce potential sources of error
- Determine how decision errors will be managed during the project

The confirmatory sampling events described in Worksheet #17 have been designed to assess the presence of 1,2-dichloropropane contamination at SWMU 17, and to assess whether there is petroleum contamination in the loess soils at SWMU 22. The sampling approaches were developed to minimize study error and optimize attainment of DQOs.

11.6.1 Sampling Strategy

The sampling strategy is designed to determine whether groundwater and soil contamination are present at SWMUs 17 and 22, respectively. Biased sampling locations will be established within the area of suspected contamination based on previous sampling activities. Sampling locations may be adjusted based on field observations and professional judgment.

11.6.2 Sources of Error

Sources of error in the site investigations may be divided into two main categories: sampling errors and measurement errors. A sampling error occurs when the sampling design, planning, and implementation do not provide for a representative range of heterogeneity at the site. A measurement error occurs because of performance variance from laboratory instrumentation, analytical methods, and operator error. The U.S. EPA identifies the combination of all these errors as a “total study error” (U.S. EPA 2006). One objective of the investigation is to reduce the total study error so that decision makers can be confident that the data collected accurately represent the chemical characteristics of the site.

11.6.3 Managing Decision Error

The investigation will utilize decision-error minimization techniques in sampling design, sampling methodologies, and laboratory measurement of contaminants of concern (COCs). Possible decision errors will be minimized during the field investigation by using the following methods:

- Use standard field sampling methodologies.
- Use applicable analytical methods and standard operating procedures (SOPs) for sample analysis by a competent analytical laboratory certified by the Department of Defense (DoD) Environmental Laboratory Accreditation Program (ELAP) to reduce measurement errors.
- Confirm analytical data to identify and control potential laboratory error and sampling error by using spikes, blanks, and replicated samples.

Decision errors associated with judgmental sampling are based on sample design and measurement errors. Assuming that the best possible professional judgment was used to develop the sampling plan (i.e., position sampling locations), the most important decision errors will be associated with field and laboratory techniques involved in the collection and analysis of the data.

Sampling Methodologies and Procedures

Possible decision errors generated by sampling errors will be minimized during the field investigation by applying standardized field sampling methodologies and standard operating procedures listed on Worksheet #21 and provided in Appendix C.

Field Data Logs

All sample information will be transcribed into a field logbook and/or onto field data sheets provided in Appendix B. Field data sheets will be e-mailed to the project management team to track progress.

Managing Laboratory Sampling Error

Control of potential laboratory error and sampling error will be minimized using spikes, blanks, and duplicate samples. Sampling error may be introduced when the laboratory chemist selects a single portion of the field sample for laboratory analysis. However, this issue is less relevant to the discrete sampling approach, as sub-sampling of the field sample is generally not implemented at the laboratory.

Analytical Laboratory Sample Management

The laboratory will provide full electronic data deliverable files, portable document format (PDF) files of the data deliverables for all project data, and a hard copy of data deliverables for all samples. Designated samples will be used to obtain necessary sub-samples for laboratory quality control (QC) measurements (i.e., analytical sample duplicates and sample matrix spike/matrix spike duplicates [MS/MSD]). Tasks will be completed using the laboratory SOPs, which will be available upon request.

Resolution Consultants will provide data validation services and verify and evaluate the usability of the data as identified in Worksheets #34 through #36.

PDF copies of all analytical data packages will be electronically stored and archived in the NAVFAC Midwest Administrative Record. All other data generated in the field and reports generated for the project will be stored as computer readable data files by Resolution Consultants.

11.7 Sampling Design

The sampling design developed to optimize resources and generate data to satisfy the DQOs is presented in Worksheet #17. Biased sampling locations will be selected within the area of suspected contamination based on previous sampling activities presented in Worksheet #10.

SAP WORKSHEET #12: FIELD QUALITY CONTROL SAMPLES

(UFP-QAPP Manual Section 2.6.2)

Measurement Performance Criteria Table — Field Quality Control Samples				
Quality Control Sample	**Analytical Group**	**Frequency**	**Data Quality Indicators**	**Measurement Performance Criteria**
Trip Blanks	VOCs	One per cooler to the laboratory containing volatiles	Accuracy/Bias/ Contamination	No analytes > ½ LOQ, except common lab contaminants, which must be < LOQ
Field Duplicates	VOCs	One per 20 field samples	Precision	Values > 5x LOQ: Relative RPD ≤30%
Matrix Spike/ Matrix Spike Duplicate	VOCs	One per 20 field samples	Accuracy/Bias/Precision	Percent Recoveries — DoD QSM Limits RPD ≤30%
Cooler Temperature Indicator	All	One per cooler	Representativeness	Temperature less than 6 degrees Celsius

Notes:

VOCs = Volatile organic compounds
LOQ = Limit of quantitation
RPD = Relative percent difference
DoD QSM = *Department of Defense Quality Systems Manual for Environmental Laboratories*, Version 4.2, October 2010

SAP WORKSHEET #17: SAMPLING DESIGN AND RATIONALE

(UFP-QAPP Manual Section 3.1.1)

17.1 General Approach

The descriptions below provide an overview of the sampling rationale for the SWMU 17 and SWMU 22 investigation. Groundwater is the media of concern at SWMU 17, and soils are the media of concern at SWMU 22. The sampling approach for each SWMU was developed in accordance with the Project Team, comprising the Navy, the TDEC DSWM and the U.S. Geological Survey.

The sample analyses and identifiers are provided in Worksheets #18, 19, 20, and 30.

17.2 SWMU 17 Groundwater Sampling Design and Rationale

SWMU 17 groundwater samples will be collected during a one-time event to determine presence and current concentration of 1,2-dichloropropane in the shallow fluvial deposits aquifer at a depth of approximately 45 to 55 feet bgs. SWMU 17 groundwater sample locations are shown on Figure 4 in Appendix A. Temporary monitoring wells will be installed using DPT methods, and will be developed, then sampled using micropurge techniques for 1,2-dichloropropane (SW-846 Method 8260B). The temporary monitoring wells will be installed and abandoned in accordance with the Shelby County Well Construction Code following the field activity and once results are received from the laboratory and validated. Procedures for the field activities listed above are listed on Worksheet #21 and provided in Appendix C.

17.3 SWMU 22 Soil Sampling Design and Rationale

SWMU 22 soil samples will be collected during a one-time event to determine current conditions of petroleum contamination in soil near the location of a former UST that reportedly contained No. 2 fuel oil and diesel fuel. Soil sampling will be performed at four locations (Figure 5) within the loess using DPT to an average depth of 10 to 15 feet bgs, which would be the typical depth for the base of a former tank pit. Soil samples will be screened by photoionization detector (PID) and one sample will be collected from each boring in the depth interval with the highest PID detection; if no interval exhibits a maximum PID detection, samples will be collected from the assumed bottom of the former tank pit. Procedures for the field activities listed above are listed on Worksheet #21 and provided in Appendix C.

Soil samples will be collected using TerraCore (or equivalent) samplers submitted for BTEX, MTBE, and naphthalene analysis by SW-846 Method 5035/8260B.

SAP WORKSHEET #14: FIELD PROJECT TASKS

(UFP-QAPP Manual Section 2.8.1)

The following project tasks are summarized below:

- Field Tasks
- Analytical Tasks
- Data Management and Review
- Project Report

FIELD TASKS

Utility Clearance — A minimum of 3 weeks prior to the commencement of any intrusive activities, Resolution Consultants will coordinate utility clearance with the NSA Mid-South point of contact and Tennessee One Call, in accordance with SOP-3-01 Mid-South (MS). Utilities will be marked at proposed sampling locations before intrusive sampling is initiated. The Resolution Consultants Field Team Leader (FTL) will document the utility clearance process and obtain all required approvals, as deemed necessary by NSA Mid-South. Utilities that are identified in the field, but not shown or incorrectly shown on the work approval documentation, will be marked directly on the document and returned to the NSA Mid-South point of contact for inclusion in the Geographic Information System database.

Mobilization/Demobilization — Mobilization will consist of the delivery, assembly (in satisfactory working order), and secure storage of necessary equipment, materials, and supplies, along with the acquisition of personnel and vehicle base access badges (SOP-MS Access). The Resolution Consultants FTL or designee will coordinate with the NSA Mid-South point of contact to identify appropriate locations for the temporary storage of equipment and supplies.

Demobilization will consist of the prompt and timely removal of equipment, materials, and supplies from the site at the completion of fieldwork. Demobilization also includes the cleanup and removal of waste generated during the investigation.

SWMU 17 Direct Push Technology Groundwater Investigation — Three temporary groundwater monitoring wells will be installed by DPT methods, completed, and developed in accordance with SOP-3-18 (MS). Upon reaching the completion depth of the borehole (approximately 45 to 55 feet bgs), temporary 1-inch diameter polyvinylchloride (PVC) monitoring wells will be constructed, with 10-foot length, pre-packed PVC screens. Groundwater samples will be collected from the temporary wells following development using dedicated tubing and peristaltic pumps, in accordance with SOP-3-13, SOP-3-14, SOP-3-17, and SOP-3-18 (MS). Sample collection and handling will be in accordance with SOP-3-03A, SOP-3-04A (MS), and SOP-3-14. All purge water will be collected in properly labeled U.S. Department of Transportation (DOT)-approved 55-gallon steel drums and staged at containment area 1625 while pending analytical data and discharge approval from the City of Millington.

SWMU 22 Soil Sampling — Soil samples will be collected at four locations from 10 to 15 feet below grade surface using DPT methods in accordance with SOP-3-18 (MS). Soil samples will be screened by a PID for organic compounds, using SOP-3-19 and SOP-3-20, and a sample will be collected from the depth interval with the highest PID detection; otherwise samples will be collected from the assumed bottom of the former tank pit. After sampling, each borehole will be backfilled to within 6 inches of grade using soil cuttings removed from the borehole and/or bentonite grout. Sample handling will be in accordance with SOP-3-03A and SOP-3-04A.

Investigation-Derived Waste — Investigative derived waste (IDW) management and sampling activities will be conducted to properly stage IDW and characterize it for disposal. IDW generated from field investigation activities will include soil cuttings and decontamination fluids. During the field investigation, waste minimization practices will be implemented to the extent practicable. IDW will be managed onsite in DOT-approved 55-gallon steel drums. Wastes such as consumable materials, supplies, and equipment will be disposed of as municipal trash in an offsite dumpster.

IDW will be characterized for disposal by evaluating environmental sampling data and by collecting and analyzing waste characterization samples. If environmental sampling data are insufficient to characterize IDW for disposal, then waste characterization samples will be collected to characterize soil and decontamination fluids for disposal. IDW will be removed and transported to an appropriate disposal facility within 90 calendar days of completing the field investigation. IDW will be managed in accordance with the procedures outlined in SOP 3-05 (MS).

Personal protective equipment, including gloves, wipes, discarded paper towels, and disposable equipment (i.e., tubing), will be bagged and properly discarded in an appropriate on-base solid waste Dumpster.

Field Decontamination — Non-disposable equipment that comes into contact with the sample medium and fluids will be decontaminated to prevent cross-contamination between sampling points. Decontamination of sampling equipment will not be necessary for dedicated and disposable samplers. Decontamination of reusable sampling equipment (e.g., non-disposable spoons and hand augers) will be conducted prior to sampling and between samples at each location. The decontamination procedures in SOP-3-06 will be followed.

Field Documentation Procedures — Field documentation will be performed in accordance with Resolution Consultants SOP-3-02. Sample collection information will be recorded in bound field notebooks or specific field forms. Samples will be packaged and shipped according to Resolution Consultants SOP-3-04A.

A summary of field activities will be properly recorded in indelible ink in a bound logbook with consecutively numbered pages that cannot be removed. Logbooks will be assigned to field personnel and stored in a secured area when not in use.

All entries will be written in indelible ink, and no erasures will be made. If an incorrect entry is made, striking a single line through the incorrect information will make the correction; and the person making the correction will initial and date the change. Boring logs, sampling forms, and other field forms will also be used to document field activities.

Surveying — Soil sampling locations will be marked in the field using a wooden stake or brightly colored pin flag. Coordinates of each sample location will be determined by Global Positioning System, in accordance with SOP-3-07.

ANALYTICAL TASKS

To support the environmental decisions, the analytical laboratory will be accredited through the DoD ELAP. The laboratory analytical data packages will contain summary forms and raw data.

Chemical analyses will be performed by Empirical Laboratories, LLC, which holds current DoD ELAP accreditation. The DoD ELAP certificate for Empirical Laboratories may be found in Appendix D. Analyses will be performed in accordance with the analytical methods identified in Worksheet #18, #19, #23, and #30 and the laboratory will strive to meet the project quantitation limit goals specified in Worksheet #15. Empirical Laboratories will perform the chemical analyses following laboratory-specific SOPs identified in Worksheet #23. Full laboratory SOPs are available upon request.

The laboratory will report soil results on a dry-weight basis. Results of percent moisture will be reported in each analytical data package and associated electronic data deliverable (EDD) files. This information will also be captured in the project database, which will eventually be uploaded to the Naval Installation Restoration Information Solution (NIRIS) database.

DATA MANAGEMENT AND REVIEW

The principal data generated for this project will be from field data and laboratory analytical data. The field forms, chain of custodys, air bills, and logbooks will be placed in the project files after the completion of the field program. The field logbooks for this project will be used only for this site, and will also be categorized and maintained in the project files after the completion of the field program. All project records will be maintained in a secure location.

Data Tracking — The Resolution Consultants Task Order Manager (TOM), or designee, is responsible for the overall tracking and control of data generated for the project. Data are tracked from generation to archiving in the project specific files. The project chemist, or designee, is responsible for tracking the samples collected and shipped to the contracted laboratory. Upon receipt of the data packages from the analytical laboratory, the project chemist will oversee the data validation effort, which includes verifying that the data packages are complete and that results for all samples have been delivered by the analytical laboratory.

Resolution Consultants shall submit all Administrative Record Files, Site Files, and Post Decision Files in accordance with the specifications defined in the NAVFAC *Environmental Restoration Recordkeeping Manual* (NAVFAC 2009). Additionally, Resolution Consultants will update and manage the project related documents, data, and maps in NIRIS. Project related spatial data including maps, models, and associated collected or created data will also be uploaded into NIRIS. All documentation submittals for NIRIS will be coordinated with the Navy RPM.

Data Storage, Archiving, and Retrieval — After the data are validated, the data packages are entered into the Resolution Consultants file system and archived in secure files. The field records including field logbooks, sample logs, chain-of-custody records, and field calibration logs will be submitted by the Resolution Consultants FTL to be entered into the file system before archiving in secure project files. Project files are audited for accuracy and completeness. Project files will be kept in a secured, limited access area. At the completion of the Navy contract, files will be shipped to the Federal Records Center for storage where the files will remain until 50 years after the last decision document for NSA Mid-South.

Data Security — Access to Resolution Consultants project files is restricted to designated personnel only. The Resolution Consultants data manager maintains the electronic data files, and access to the data files is restricted to qualified personnel only. File and data backup procedures are routinely performed.

Electronic Data — Laboratory data, provided in electronic format, will be verified for accuracy prior to use and during the data validation process. After data are validated, the electronic data results will be uploaded into the Resolution Consultants database for use in data evaluation and subsequent report preparation. The project database will be on a password protected secure network and access to changing data files will be restricted to qualified personnel. The Resolution Consultants TOM (or designee) is responsible for the overall tracking and control of data generated for the project. All final electronic data and administrative records will be compiled and uploaded into NIRIS for final repository.

Data Review and Validation — After receipt of analytical laboratory results, Resolutio Consultants will verify data completeness as specified on Worksheet #34. To ensure that the analytical results meet the project quality objectives, the laboratory data will undergo verification and validation as cited in Worksheets #34 through #36 and described below.

Prior to data validation, electronic laboratory data will be verified for accuracy against the hardcopy laboratory report and the electronic quality assurance project plan (eQAPP) will be established using the project-specific criteria defined in Worksheets #12, #19, and #28. The laboratory will be requested to resubmit electronic data found to be inaccurate.

During the data validation process, the Resolution Consultants Data Validation Assistant (DVA) tool will be used to review method accuracy and precision data from field and laboratory QC samples contained in the laboratory EDD and to qualify that data according to the project-specific eQAPP. The DVA tool uses EarthSoft's EQuIS relational database to assemble a series of Excel worksheets into a DVA workbook for the validator that present:

- data validation QC elements that need review, compared to control limits stored in the project-specific eQAPP;

- associated sample results for duplicated samples and blanks;

- a place to make the necessary qualifications and result updates directly into an electronic format documentation of qualifications using coded reasons; and

- a list of all samples affected by the qualification.

Laboratory calibration will be assessed against the criteria presented in the DoD *Quality Systems Manual* using the hardcopy laboratory report; the results of these findings will be added to the Excel DVA workbook. The DVA workbook is used to update the project database with the validator's changes, eliminating the manual data entry process and allowing for 100 percent of data to be reviewed prior to uploading to the project database.

PROJECT REPORTS

All field activities associated with the SWMU 17 and SWMU 22 investigation will be incorporated into a Task Summary report, which will include a summary of the completed tasks, well construction logs, field records, water quality parameters, groundwater flow maps, groundwater monitoring data, and deviations that may have occurred from the original work plan.

All administrative record files, post decision files, and site files will be submitted to the NIRIS data management system in accordance with the *Environmental Restoration Recordkeeping Program Manual, Appendix G, NAVFAC Contractor Work Instruction* (NAVFAC 2009)

SAP WORKSHEET #21: FIELD SOPs REFERENCE TABLE

(UFP-QAPP Manual Section 3.1.2)

Field SOPs Reference Table					
SOP Reference Number	**Title/Author**	**Revision Date or Version Number**	**Location of SOP**	**Any planned deviation for Project Work**	**Comments**
SOP-3-01 (MS)	Utility Clearance/Resolution Consultants	Revision 1; June 2013	Appendix C	No	
SOP-3-02	Field Log Books/Resolution Consultants	Revision 0; May 2012	Appendix C	No	
SOP-3-03A	Sample Labeling and Chain-of-Custody/Resolution Consultants	Revision 0; August 2012	Appendix C	No	
SOP-3-04 (MS)	Packaging and Shipping Procedures for Low Concentration Samples/Resolution Consultants	Revision 0; May 2012	Appendix C	No	
SOP-3-05 (MS)	Investigative Derived Waste Management/Resolution Consultants	Revision 1; June 2013	Appendix C	No	
SOP-3-6	Equipment Decontamination/Resolution Consultants	Revision 0; May 2012	Appendix C	No	
SOP-3-7	Land Surveying/Resolution Consultants	Revision 0; August 2012	Appendix C	No	
SOP-3-08 (MS)	Soil Classification/Resolution Consultants	Revision 0; May 2012	Appendix C	No	
SOP-3-13	Monitoring Well Development	Revision 0; June 2012	Appendix C	No	
SOP-3-14	Monitoring Well Sampling/Resolution Consultants	Revision 0; May 2012	Appendix C	No	
SOP-3-17	Water Quality Parameter Testing for Groundwater Sampling/Resolution Consultants	Revision 0; May 2012	Appendix C	No	
SOP-3-18 (MS)	Direct Push Sampling Techniques/Resolution Consultants	Revision 0; May 2012	Appendix C	No	
SOP-3-19	Headspace Screening for VOCs/Resolution Consultants	Revision 0; May 2012	Appendix C	No	
SOP-3-20	Operation and Calibration of a Photoionization Detector	Revision 0; May 2012	Appendix C	No	
SOP-MS Access	NSA Mid-South Installation Access	Revision 0; April 2013	Appendix C	No	

Notes:
SOP = Standard operating procedure
MS = Mid-South

SAP WORKSHEETS #18, 19, 20, AND 30: LOCATION-SPECIFIC SAMPLING METHODS/SOP REQUIREMENTS TABLE

(UFP-QAPP Manual Sections 3.1.1 and 3.5.2.3)

Field Project Implementation (Field Project Instructions)

Sample Details

Naval Support Activity Mid-South Contract Task Order F27B — SWMU 17

SWMU 17 Fluvial Groundwater Sampling

Laboratory: Empirical Laboratories, LLC
621 Mainstream Drive, Suite 270, Nashville, Tennessee 37228,
615-345-1115, Sonya Gordon, sgordon@empirlabs.com

Analysis Group:	**1,2-Dichloropropane**
Preparation and Analytical Method:	SW846 5030B/8260B
Analytical Laboratory SOP Reference:	SOP 202
Data Package Turnaround Time:	21 Days
Container Type/Volume required:	3 — 40 mL glass vials
Preservative:	Hydrochloric acid to pH <2; Cool to ≤ 6C; no headspace

Site	Matrix	Station ID	Sample ID	Coordinates X	Coordinates Y	Depth/Sampling Intervals	
SWMU 17	Groundwater	017G01LF	017G01LF-MMYY	TBD[1]	TBD[1]	TBD	1
SWMU 17	Groundwater	017G02LF	017G02LF-MMYY	TBD[1]	TBD[1]	TBD	1
SWMU 17	Groundwater	017G03LF	017G03LF-MMYY	TBD[1]	TBD[1]	TBD	1
Field Quality Control Samples							
SWMU 17	Field Duplicate	TBD	TBD	NA	NA		1
SWMU 17	Trip Blank	TBD	TBD	NA	NA		1
SWMU 17	Matrix Spike/Matrix Spike Duplicate	TBD	TBD	NA	NA		1
Total Number of Samples to the Laboratory							6

Notes:
[1] Coordinates will be determined by a State of Tennessee licensed land-surveyor.
SOP = Standard operating procedure
SWMU = Solid Waste Management Unit
TBD = To be determined
mL = Milliliter
MMYY = Month and Year of sampled collected
NA = Not applicable
For field quality control sample scoping, the sampling event is anticipated to last one day. Frequency of quality assurance/quality control sample collection:
Field Duplicate — One per 20 samples
Matrix spike/matrix spike duplicate — One per 20 samples
Trip Blank — One per cooler to the laboratory containing volatiles

SAP WORKSHEETS #18, 19, 20, AND 30: LOCATION-SPECIFIC SAMPLING METHODS/SOP REQUIREMENTS TABLE (continued)

Sample Details							
Naval Support Activity Mid-South Contract Task Order F27B — SWMU 22 **SWMU 22 Loess Soil Sampling** **Laboratory:** Empirical Laboratories, LLC 621 Mainstream Drive, Suite 270, Nashville, Tennessee 37228, 615-345-1115, Sonya Gordon, sgordon@empirlabs.com						**Analysis Group:**	**BTEX, MTBE, Naphthalene**
						Preparation and Analytical Method:	SW846 5035/8260B
						Analytical Laboratory SOP Reference:	SOP 202
						Data Package Turnaround Time:	21 Days
						Container Type/Volume required:	3 — 40 mL glass vials plus 2 ounce jar
						Preservative:	Methanol and sodium bisulfate; Cool to ≤ 6C
				Coordinates			
Site	**Matrix**	**Station ID**	**Sample ID[1]**	**X**	**Y**	**Depth/Sampling Intervals**	
SWMU 22	Soil	022S35LS	022S35LS-XX	TBD[1]	TBD[1]	TBD	1
SWMU 22	Soil	022S36LS	022S36LS-XX	TBD[1]	TBD[1]	TBD	1
SWMU 22	Soil	022S37LS	022S37LS-XX	TBD[1]	TBD[1]	TBD	1
SWMU 22	Soil	022S38LS	022S38LS-XX	TBD[1]	TBD[1]	TBD	1
Field Quality Control Samples							
SWMU 22	Field Duplicate	TBD	TBD	NA	NA		1
SWMU 22	Trip Blank	TBD	TBD	NA	NA		1
SWMU 22	Matrix Spike/Matrix Spike Duplicate	TBD	TBD	NA	NA		1
Total Number of Samples to the Laboratory							7

Notes:
[1] Coordinates will be determined by a State of Tennessee licensed land-surveyor.

SOP = Standard operating procedure
BTEX = benzene, toluene, ethylbenzene, xylene
MTBE = Methyl tert-butyl ether
MMYY = Month and Year of sampled collected
XX = Interval at which the sample is collected (in feet)
mL = Milliliter
SWMU = Solid Waste Management Unit
TBD = To be determined
NA = Not applicable

For field quality control sample scoping, the sampling event is anticipated to last one day. Frequency of quality assurance/quality control sample collection:

Field Duplicate — One per 20 samples
Matrix spike/matrix spike duplicate — One per 20 samples
Trip Blank — One per cooler to the laboratory containing volatiles

SAP WORKSHEET #15: REFERENCE LIMITS AND EVALUATION TABLES

(UFP-QAPP Manual Section 2.8.1)

Reference Limits and Evaluation Table							
Matrix:	Groundwater						
Analytical Group:	1,2-Dichloropropane						
					Laboratory Specific Limits		
Analyte	**CAS**	**Project Action Level (µg/L)**	**Project Action Level Source**	**Project Quantitation Limit Goal (µg/L)**	**LOQ (µg/L)**	**LOD (µg/L)**	**DL (µg/L)**
1,2-Dichloropropane	78-87-5	5	MCL	1.7	1.0	0.50	0.25

Notes:
CAS = Chemical abstracts service
µg/L = Micrograms per liter
MCL = U.S. Environmental Protection Agency Maximum Contaminant Level
LOQ = Limit of quantitation
LOD = Limit of detection
DL = Detection limit

SAP WORKSHEET #15: REFERENCE LIMITS AND EVALUATION TABLE (continued)

Reference Limits and Evaluation Table							
Matrix:	Soil						
Analytical Group:	Selected Volatile Organic Compounds						
					Laboratory Specific Limits		
Analyte	**CAS**	**Project Action Level (mg/kg)**	**Project Action Level Source**	**Project Quantitation Limit Goal (mg/kg)**	**LOQ (mg/kg)**	**LOD (mg/kg)**	**DL (mg/kg)**
Benzene	71-43-2	0.0729	TDEC UST	0.0243	0.005	0.0025	0.00125
Toluene	108-88-3	6.78	TDEC UST	2.3	0.005	0.0025	0.00125
Ethyl benzene	100-41-4	143	TDEC UST	48	0.005	0.0025	0.00125
Total xylenes	1330-20-7	9.6	TDEC UST	3.2	0.015	0.0075	0.00375
Naphthalene	91-20-3	135	TDEC UST	45	0.005	0.0025	0.00125
Methyl tert-butyl ether	1634-04-4	39.6	TDEC UST	13.2	0.005	0.0025	0.00125

Notes:

CAS	=	Chemical abstracts service
mg/kg	=	Milligrams per kilogram
LOQ	=	Limit of quantitation
LOD	=	Limit of detection
DL	=	Detection limit
TDEC UST	=	Tennessee Department of Environment and Conservation Underground Storage Tank Risk-based clean-up levels, effective 1 April 2007

SAP WORKSHEET #23: ANALYTICAL SOP REFERENCES TABLE

(UFP-QAPP Manual Section 3.2.1)

Analytical SOP References Table

Empirical Laboratories, LLC
621 Mainstream Drive, Suite 270
Nashville, Tennessee 37228
Sonya Gordon 615-345-1115

Lab SOP Number	Title, Revision Date, and Number	Definitive or Screening Data	Analytical Group and Matrix	Instrument	Variance to QSM	Modified for Project Work? (Yes/No)
Empirical SOP202	*GC/MS Volatiles by EPA Method 624 & SW846 Method 8260B Including Appendix IX Compounds*, Rev226 01/08/2013	Definitive	VOCs — Groundwater and QC blanks	Agilent GC/MS	None	No

Notes:

SOP	=	Standard operating procedure
QSM	=	*Department of Defense Quality Systems Manual for Environmental Laboratories*, Version 4.2, October 2010
VOC	=	Volatile organic compounds
QC	=	Quality control
GC/MS	=	Gas chromatography/mass spectrometer

SAP WORKSHEET #28: LABORATORY QC SAMPLES TABLE

(UFP-QAPP Manual Section 3.4)

Matrix:	Soil and Groundwater
Analytical Group:	Volatile Organic Compounds
Analytical Method:	SW-846 5030B/8260B (Groundwater); SW-846 5035/8260B (Soil)
SOP Reference:	Empirical SOP202

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicators	Measurement Performance Criteria
Method Blank	One per batch of 20 or fewer samples per matrix	No analytes detected > ½ LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > LOQ. (See Box D-1 in DoD QSM V4.2.).	Correct problem; re-prepare and/or reanalyze any sample associated with a blank that fails criteria.	Analyst, Supervisor, QA Manager	Bias Contamination	See Method/SOP QC Acceptance Limit Column
Surrogates	All field and QC samples	**DoD QSM Surrogate Limits** / **Soil %R** / **Water %R** 1,2-Dichloroethane-d4: 75-140* / 70-120 4-Bromofluorobenzene: 85-120 / 75-120 Dibromofluoromethane: 80-125* / 85-115 Toluene-d8: 85-115 / 85-120 * Laboratory limit is used; %R not listed in DoD QSM.	Re-prepare and/or reanalyze if sufficient sample is available. If reanalysis confirms failing recoveries, report and narrate.	Analyst, Supervisor, QA Manager	Accuracy Bias	QC acceptance criteria specified in DoD QSM Version 4.2 See Method/SOP QC Acceptance Limit Column
LCS and, if required, LCSD	One per batch of 20 or fewer samples per matrix	QC acceptance criteria specified in Table G-6 of DoD QSM Version 4.2. RPD must be ≤30 Between LCS and LCSD, if performed.	Correct problem, then re-prepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	Analyst, Supervisor, QA Manager	Accuracy Bias	QC acceptance criteria specified in Table G-6 of DoD QSM Version 4.2 See Method/SOP QC Acceptance Limit Column
Internal Standards	In all field samples and standards	Retention time ±30 seconds from retention time of the midpoint standard in the ICAL; EICP area within -50% to +100% of ICAL midpoint standard.	Inspect instruments for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning. If reanalysis confirms matrix interference, report sample and narrate.	Analyst, Supervisor, QA Manager	Accuracy Bias	See Method/SOP QC Acceptance Limit Column

SAP WORKSHEET #28: LABORATORY QC SAMPLES TABLE (Continued)

(UFP-QAPP Manual Section 3.4)

Matrix:	Soil and Groundwater
Analytical Group:	Volatile Organic Compounds
Analytical Method:	SW-846 5030B/8260B (Groundwater); SW-846 5035/8260B (Soil)
SOP Reference:	Empirical SOP202

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicators	Measurement Performance Criteria
MS/MSD	One per batch of 20 or fewer samples per matrix	For matrix accuracy evaluation, use LCS recovery criteria; RPD $\leq$ 30.	Corrective actions will not be taken for samples when recoveries are outside limits and surrogate and LCS criteria are met. If both the LCS and MS/MSD %Rs are unacceptable, then re-prepare and reanalyze the samples and QC samples.	Analyst, Supervisor, QA Manager	Accuracy Bias Precision	See Method/SOP QC Acceptance Limit Column

Notes:

SOP	=	Standard operating procedure
QC	=	Quality control
LOQ	=	Limit of quantitation
DOD QSM	=	*Department of Defense Quality Systems Manual for Environmental Laboratories*, Version 4.2, October 2010
QA	=	Quality assurance
%R	=	Percent recovery
LCS	=	Laboratory control sample
LCSD	=	Laboratory control sample duplicate
RPD	=	Relative percent difference
ICAL	=	Initial calibration
EICP	=	Extracted ion current profile
MS/MSD	=	Matrix spike/matrix spike duplicate

SAP WORKSHEETS #34 — 36: DATA VERIFICATION AND VALIDATION (STEPS I AND IIA/IIB) PROCESS TABLE

(UFP-QAPP Manual Section 5.2.1, UFP-QAPP Manual Section 5.2.2, Figure 37 UFP-QAPP Manual, Table 9 UFP-QAPP Manual)

Data Review Input	Description	Responsible for Verification (name, organization)	Step I/ IIa/IIb [1]	Internal/ External
Verification Chain-of-custody forms Sample Login/Receipt	Review the sample shipment for completeness, integrity, and sign accepting the shipment. All sample labels will be checked against the chain-of-custody form, and any discrepancies will be identified, investigated, and corrected. The samples will be logged in at every storage area and work station required by the designated analyses. Individual analysts will verify the completeness and accuracy of the data recorded on the forms.	Laboratory sample custodians and analysts, Empirical Laboratories, LLC	I	Internal
Verification Chain-of-custody forms	Check that the chain-of-custody form was signed/dated by the sampler relinquishing the samples and by the laboratory sample custodian receiving the samples for analyses.	Project chemist or data validators, Resolution Consultants	I	External
Verification SAP sample tables	Verify that all proposed samples listed in the SAP tables have been collected.	FTL or designee, Resolution Consultants	I	Internal
Verification Sample log sheets and field notes	Verify that information recorded in the log sheets and field notes are accurate and complete.	FTL or designee, Resolution Consultants	I	Internal
Verification Field QC samples	Check that field QC samples, described in Worksheet #12 and listed in Worksheet #20, were collected as required.	FTL or designee, Resolution Consultants	I	Internal
Verification Analytical data package	Verify all analytical data packages will be verified internally for completeness by the laboratory performing the work. The laboratory project manager (or designee) will sign the case narrative for each data package.	Laboratory project manager, Empirical Laboratories, LLC	I	Internal
Verification Analytical data package	Verify the data package for completeness. Missing information will be requested from the laboratory and validation (if performed) will be suspended until missing data are received.	FTL, Project chemist or data validators, Resolution Consultants	I	External
Verification Electronic data deliverables	Verify the electronic data against the chain-of-custody and hard copy data package for accuracy and completeness.	Data manager and/or validator, Resolution Consultants	I	External
Validation Chain-of-custody	Examine the traceability of the data from time of sample collection until reporting of data. Ensure that the custody and integrity of the samples were maintained from collection to analysis and the custody records are complete and any deviations are recorded.	Project chemist or data validators, Resolution Consultants	IIa	External
Validation Holding Times	Review that the samples were shipped and stored at the required temperature and sample pH for chemically-preserved samples meet the requirements listed in Worksheet #19. Ensure that the analyses were performed within the holding times. If holding times were not met, confirm that deviations were documented.	Project chemist or data validators, Resolution Consultants	IIa	External

SAP WORKSHEETS #34 — 36: DATA VERIFICATION AND VALIDATION (STEPS I AND IIA/IIB) PROCESS TABLE (Continued)

(UFP-QAPP Manual Section 5.2.1, UFP-QAPP Manual Section 5.2.2, Figure 37 UFP-QAPP Manual, Table 9 UFP-QAPP Manual)

Data Review Input	Description	Responsible for Verification (name, organization)	Step I/ IIa/IIb [1]	Internal/ External
Validation Sample results for representativeness	Check that the laboratory recorded the temperature at sample receipt and the pH of the chemically preserved samples to ensure sample integrity from sample collection to analysis.	Project chemist or data validators, Resolution Consultants	IIa/IIb	External
Validation Laboratory data results for accuracy	Ensure that the laboratory QC samples were analyzed and that the measurement performance criteria, listed in Worksheet #28, were met for all field samples and QC analyses. Check that specified field QC samples were collected and analyzed, as listed in Worksheet #12, and that the analytical QC criteria were met.	Project chemist or data validators, Resolution Consultants	IIa/IIb	External
Validation Field and laboratory duplicate analyses for precision	Check the field sampling precision by calculating the RPD for field duplicate samples. Check the laboratory precision by reviewing the RPD or percent difference values from laboratory duplicate analyses; MS/MSDs; and LCS/LCSDs. Ensure compliance with the precision goals listed in Worksheet #12 and 28.	Project chemist or data validators, Resolution Consultants	IIa/IIb	External
Validation Project action limits	Assess and document the impact on matrix interferences or sample dilutions performed because of the high concentration of one or more contaminant, on the other target compounds reported as undetected.	Project chemist or data validators, Resolution Consultants	IIa/IIb	External
Validation Data quality assessment report	Summarize deviations from methods, procedures, or contracts. Qualify data results based on method or QC deviation and explain all the data qualifications. Present tabular qualified data and data qualifier codes and summarize data qualification outliers. Determine if the data met the measurement performance criteria and determine the impact of any deviations on the technical usability of the data.	Project chemist or data validators, Resolution Consultants	IIa/IIb	External
Validation SAP QC sample documentation	Ensure that all QC samples specified in the SAP were collected and analyzed and that the associated results were within acceptance limits.	Project chemist or data validators, Resolution Consultants	IIa/IIb	External
Validation Analytical data deviations	Determine the impact of any deviation from sampling or analytical methods and laboratory SOP requirements and matrix interferences effect on the analytical results.	Project chemist or data validators, Resolution Consultants	IIb	External
Validation Project quantitation limits for sensitivity	Ensure that the project detection limits were achieved.	Project chemist or data validators, Resolution Consultants	IIb	External

SAP WORKSHEETS #34 — 36: DATA VERIFICATION AND VALIDATION (STEPS I AND IIA/IIB) PROCESS TABLE (Continued)

(UFP-QAPP Manual Section 5.2.1, UFP-QAPP Manual Section 5.2.2, Figure 37 UFP-QAPP Manual, Table 9 UFP-QAPP Manual)

<table>
<tr><th>Data Review Input</th><th>Description</th><th>Responsible for Verification (name, organization)</th><th>Step I/ IIa/IIb [1]</th><th>Internal/ External</th></tr>
<tr><td>Validation
Soil and Groundwater Chemical Data — VOCs</td><td>Validate VOCs data using measurement performance criteria provided in the DoD QSM, and those listed in Worksheets # 12, 19, and 28. All data will be validated and raw instrument outputs assessed and recalculated for 10% of the reported results. U.S. EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review (U.S. EPA June 2008) will be used as guidance on applying qualifiers when measurement performance criteria identified in the DoD QSM, and Worksheets #12, 19, and 28 are not met.</td><td>Project chemist or data validators, Resolution Consultants</td><td>IIa/IIb</td><td>External</td></tr>
<tr><td>Validation
Data qualifiers</td><td>Qualifiers that will be applied during the analytical data validation process are summarized below and, as indicated, results will be considered usable for interpretation unless the results are rejected when extreme data quality indicator failures are noted. Data will be rejected only after consultation with the Navy Remedial Project Manager and the Navy Quality Assurance Office/Chemist.
<table>
<tr><th>Data Qualifier</th><th>Qualifier Definition</th><th>Interpret Result As a Detection?</th><th>Result Usable?</th><th>Potential Result Bias</th></tr>
<tr><td>no qualifier</td><td>Acceptable</td><td>Yes</td><td>Yes</td><td>None expected</td></tr>
<tr><td>J</td><td>Estimated</td><td>Yes</td><td>Yes</td><td>High or Low</td></tr>
<tr><td>U</td><td>Undetected</td><td>No</td><td>Yes</td><td>None expected</td></tr>
<tr><td>UJ</td><td>Undetected and Estimated</td><td>No</td><td>Yes</td><td>High or Low</td></tr>
<tr><td>UR</td><td>Undetected and Rejected</td><td>No</td><td>No</td><td>Unspecified</td></tr>
<tr><td>R</td><td>Rejected</td><td>No</td><td>No</td><td>Unspecified</td></tr>
</table></td><td>Project chemist or data validators, Resolution Consultants</td><td>IIa/IIb</td><td>External</td></tr>
</table>

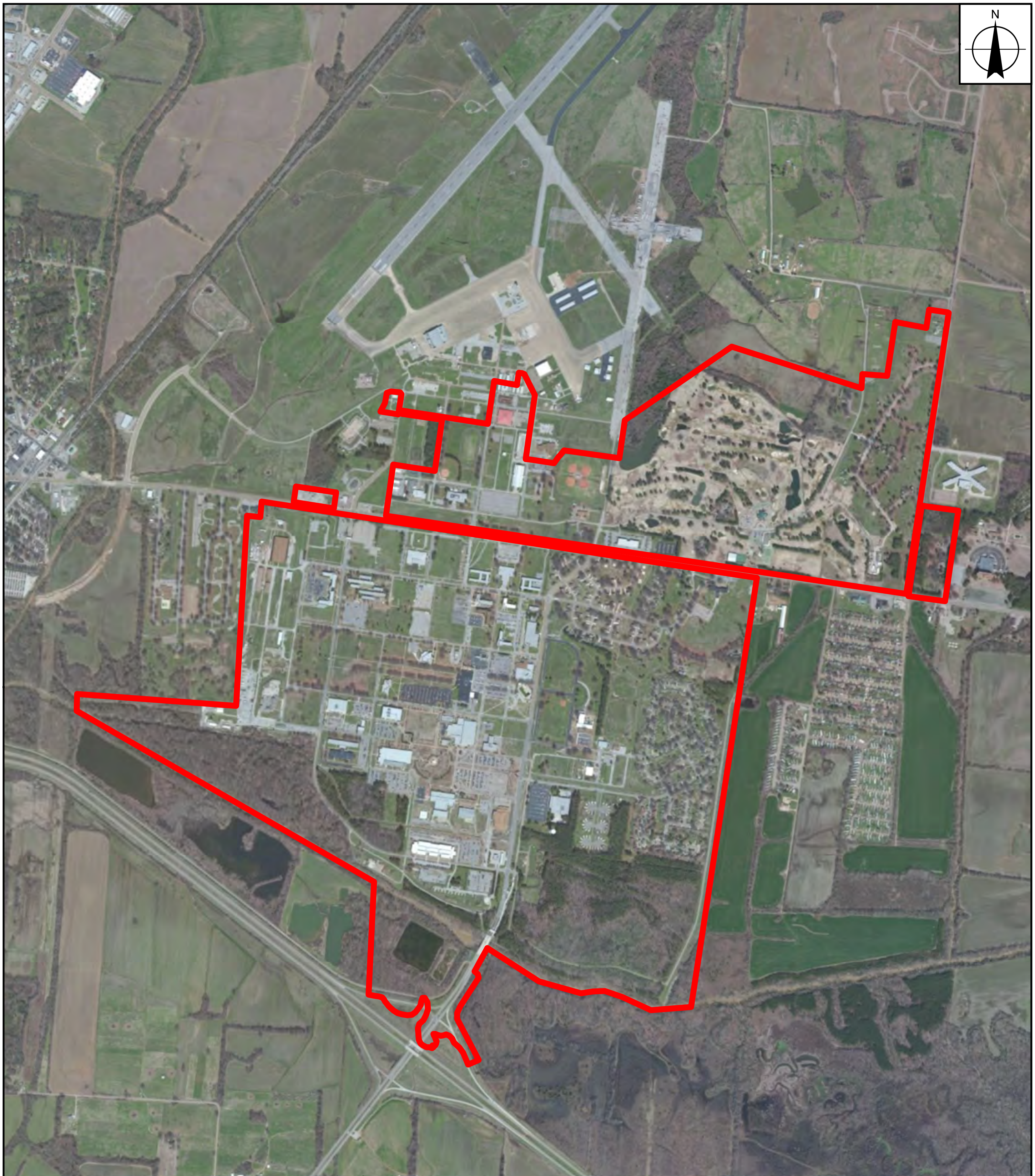
Notes:

[1] IIa=compliance with methods, procedures, and contracts [see Table 10, page 117, UFP-QAPP manual, V.1, March 2005.]
IIb=comparison with measurement performance criteria in the SAP [see Table 11, page 118, UFP-QAPP manual, V.1, March 2005]

SAP = Sampling and analysis plan
FTL = Field team leader
QC = Quality control
RPD = Relative percent difference
MS/MSD = Matrix spike/Matrix Spike duplicate
LCS/LCSD = Laboratory control sample/laboratory control sample duplicate
SOP = Standard operating procedure
VOCs = Volatile organic compounds
DoD QSM = *Department of Defense Quality Systems Manual for Environmental Laboratories*, Version 4.2, October 2010
U.S. EPA = U.S Environmental Protection Agency

Appendix A

Figures



Legend

Property Boundary

0 2,000 4,000 Feet

Some data are from Tetra Tech.

FIGURE 1
BASE LOCATION MAP
NSA MIDSOUTH
MILLINGTON, TN

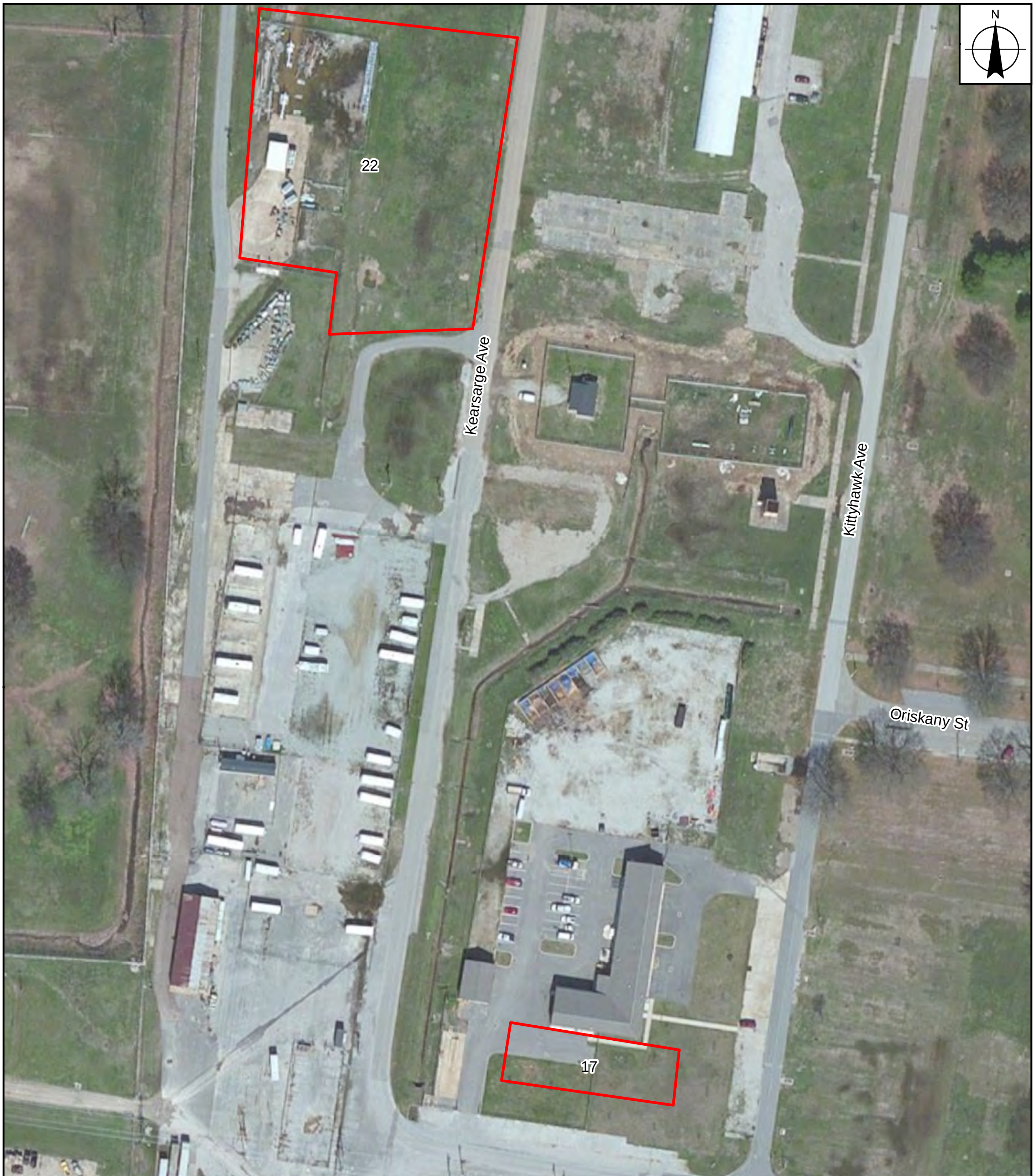
NAVFAC Naval Facilities Engineering Command

RESOLUTION CONSULTANTS

REQUESTED BY: C. COLEMAN	DATE: 11/18/2013
DRAWN BY: blipscomb	TASK ORDER NUMBER: XXXX

X:\Navy\NSA_Midsouth\Fig1_Site_Loc_Map_MS.mxd

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



X:\Navy\NSA_Midsouth\Fig2_Loc_Map.mxd

Legend

SWMU Boundary

0 150 300 Feet

FIGURE 2
LOCATION MAP
SWMU 17 AND SWMU 22
NSA MIDSOUTH
MILLINGTON, TN

NAVFAC Naval Facilities Engineering Command

RESOLUTION CONSULTANTS

REQUESTED BY: C. COLEMAN	DATE: 11/18/2013
DRAWN BY: blipscomb	TASK ORDER NUMBER: XXXX

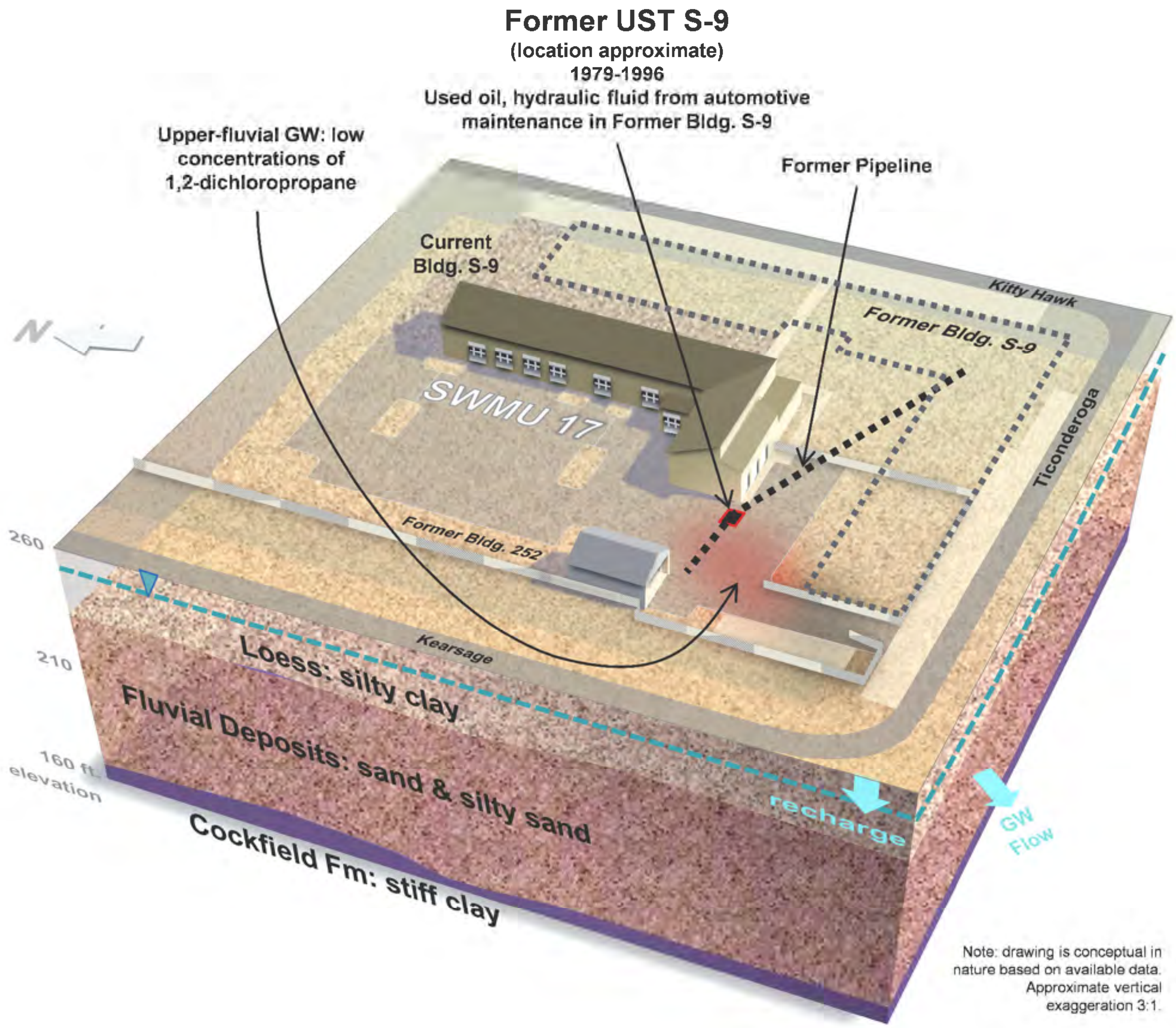


FIGURE 3A
SWMU 17 CONCEPTUAL SITE MODEL
NSA MIDSOUTH
MILLINGTON, TN

NAVFAC Naval Facilities Engineering Command

RESOLUTION CONSULTANTS

REQUESTED BY: L. HUGHES	DATE: 8/14/2013
DRAWN BY: BLIPSCOMB	TASK ORDER NUMBER: XXXX

X:\Navy\NSA_Midsouth\swmu_17_CSM.mxd

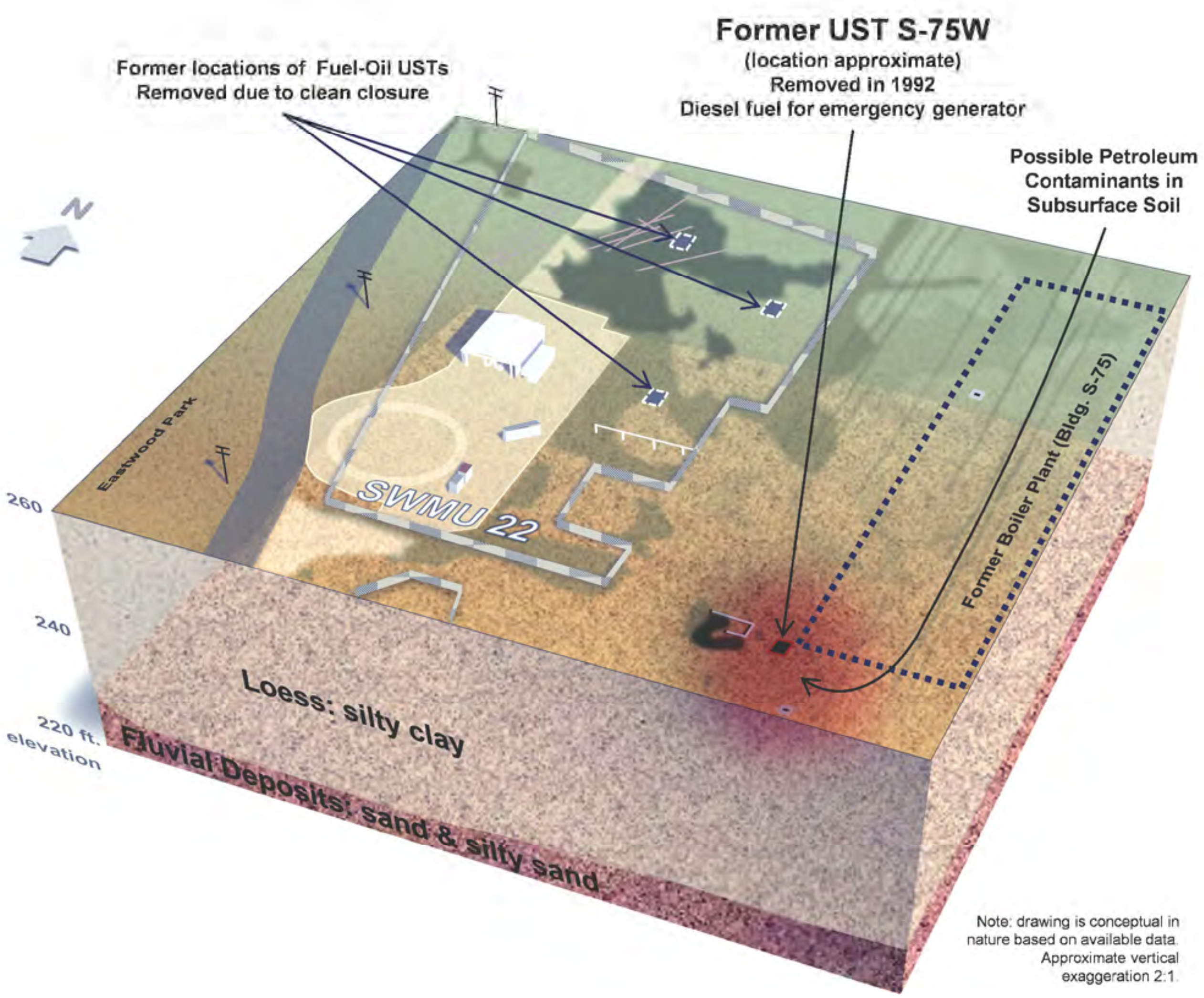


FIGURE 3B
SWMU 22 CONCEPTUAL SITE MODEL
NSA MIDSOUTH
MILLINGTON, TN

NAVFAC Naval Facilities Engineering Command

RESOLUTION CONSULTANTS

REQUESTED BY: L. HUGHES	DATE: 8/14/2013
DRAWN BY: BLIPSCOMB	TASK ORDER NUMBER: XXXX

X:\Navy\NSA_Midsouth\swmu_22_CSM.mxd

FIGURE 4
PROPOSED SAMPLE LOCATIONS
AND SAMPLE ID
SWMU 17
NSA MIDSOUTH
MILLINGTON, TN

Legend

- Temporary Monitoring Well Location
- Approximate Location of 1,2 DCP exceedance
- Former Pipe Trench
- Building Outline
- Approximate Location of Former UST
- SWMU Boundary

0 60 120 Feet

Some data are from Tetra Tech.

NAVFAC Naval Facilities Engineering Command

RESOLUTION CONSULTANTS

REQUESTED BY: C. COLEMAN	DATE: 11/18/2013
DRAWN BY: blipscomb	TASK ORDER NUMBER: XXXX

X:\Navy\NSA_Midsouth\swmu_17_samples_nav.mxd

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Legend

- Soil Sample Location
- Building Outline
- Appoximate Location of UST
- SWMU Boundary

0 60 120 Feet

Some data are from Tetra Tech.

FIGURE 5
PROPOSED SAMPLE LOCATIONS
AND SAMPLE ID
SWMU 22
NSA MIDSOUTH
MILLINGTON, TN

NAVFAC Naval Facilities Engineering Command

RESOLUTION CONSULTANTS

REQUESTED BY: C. COLEMAN	DATE: 11/18/2013
DRAWN BY: blipscomb	TASK ORDER NUMBER: XXXX

X:\Navy\NSA_Midsouth\swmu_22_samples_nav.mxd

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Appendix B
Field Forms

ENSAFE

WELL DEVELOPMENT & GROUNDWATER SAMPLING FORM

DATE:	JOB NUMBER:	EQUIPMENT (Make/Model #/Serial #):
PROJECT:	EVENT:	/ /
WELL ID:	LOCATION:	/ /
WEATHER CONDITIONS:	AMBIENT TEMP:	/ /
REVIEWED BY:	PERSONNEL:	/ /

WELL DIA:	**WELL DEVELOPMENT**	
TOTAL DEPTH from TOC (ft.):	START:	FINISH:
DEPTH TO WATER from TOC (ft.):	VOLUME PURGED (gal):	
LENGTH OF WATER COL. (ft.):	**GROUNDWATER SAMPLING**	
1 VOLUME OF WATER (gal):	START:	FINISH:
3 VOLUMES OF WATER (gal):	VOLUME PURGED (gal):	
	ANALYSIS:	

WELL DEVELOPMENT PARAMETERS		GW SAMPLING PARAMETERS	
Temperature:	± 1.0° C	Temperature:	± 0.2° C
pH:	± 0.5 standard units	pH:	± 0.2 standard units
Specific Conductance:	± 10% of the past measurement	Specific Conductance:	± 5% of the past measurement
Turbidity:	relatively stable	DO:	≤ 20% saturation
		ORP:	± 10 millivolts
		Turbidity:	≤ 10 NTU

IN-SITU TESTING

Circle one: DEVELOPMENT SAMPLING ☐ Bailer ☐ Pump Description:

Time (hh:mm):												
pH (units):												
Conductivity (mS/cm):												
Turbidity (NTU):												
DO (mg/L): YSI 556												
DO (mg/L): YSI 550												
Temperature (C°):												
ORP (mV):												
Volume Purged (gal):												
Depth to Water (ft):												
								Well Goes Dry While Purging ☐				

SAMPLE DATA

☐ Bailer ☐ Pump Description:

Sample ID	Date (m/d/y)	Time (hh:mm)	Bottles (total to lab)	Filtered (0.45 μm)	Remarks

Purging/Sampling Device Decon Process:

COMMENTS:

Purge water placed in drum#_______________

Page __ of __

ENSAFE

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION
	DRILLING METHOD:		BORING NO.
			SHEET OF
	SAMPLING METHOD:		DRILLING
			START / FINISH
	WATER LEVEL		TIME / TIME
	TIME		
	DATE		DATE / DATE
DATUM / ELEVATION	CASING DEPTH		

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT SAMPLER	VAPOR CONCENTRATIONS (PPM)	DEPTH IN FEET	SOIL GRAPH	SURFACE CONDITIONS:
						0		
						1		
						2		
						3		
						4		
						5		
						6		
						7		
						8		
						9		
						0		
						1		
						2		
						3		
						4		
						5		
						6		
						7		
						8		
						9		
						0		

DRILLING CONTR. ____________

BY ____________ DATE ____________ CHK'D BY ____________

Field Instrument Calibration Form

Calibrated by: ______________________ **Equipment (Make/Model/Serial#):** ______________________

Date: ______________________ **Equipment (Make/Model/Serial#):** ______________________

pH (su) — Standard: ± 0.2 standard units

Initial Calibration / Initial Calibration Verification

	Hach SL	Reading	Pine SL	Reading
pH7				
pH4				

Continuing Calibration Verification

	Hach SL	Reading	Deviation	Acceptable Variance (Y/N)
pH7				
pH4				

DO (mg/L) — Standard: ± 0.3 mg/L of theoretical*

IC (Temp:) / **ICV (Temp:)**

Saturation (%)	Reading (%)	Theoretical (mg/L)	Reading (mg/L)
100			

CCV (Temp:)

Saturation (%)	Reading (%)	Deviation	Acceptable Variance (Y/N)
100			

Theoretical (mg/L)	Reading (mg/L)	Deviation	Acceptable Variance (Y/N)

ORP (mV) — Standard: NA

IC (Zobell SL:) / **ICV (Pine SL:)**

TCS (Std/Temp)	Reading	TCS (Std/Temp)	Reading

CCV (Zobell SL:)

TCS (Std/Temp)	Reading	Deviation	Acceptable Variance (Y/N)

Turbidity (ntu) — Standard: ±10% of Standard

Initial Calibration

Standard	Reading

Continuing Calibration Verification

Standard	Reading	Deviation	Acceptable Variance (Y/N)

Conductivity (ms^c/cm) — Standard: ± 5% of standard value

IC (YSI SL:) / **ICV (Pine SL:)**

Standard	Reading	Standard	Reading

CCV (YSI SL:)

Standard	Reading	Deviation	Acceptable Variance (Y/N)

Comments:

____

____

____

____

Notes:

SL	solution lot	su	standard units
TCS	temperature corrected standard	mV	millivolts
Std	standard	%	percent
Temp	temperature	mg/L	milligrams per liter
ntu	Nephelometric Turbidity Units	°C	degrees Celsius
ms^c/cm	millisiemens per centimeter (temperature corrected)	*	Theoretical value listed on Table FT 1500-1 (attached)

NAVSUPPACT MID-SOUTH BUILDING CAC ACCESS / ISSUE APPLICATION					
From: ENVIRONMENTAL DIVISION **To:** Email to MILL_BADGE@NAVY.MIL **Subj:** Request for Identification Badge, and access to restricted spaces					
APPLICANT INFORMATION					
Name (Last, First, Middle Initial)	**Gender:**	**Citizenship:**	**SSN:**		
Command/Dep. NAVFAC/PWD Mid-South	**Title:**		**Date of Birth:**		
Race:	**State Drivers License#:**				
Height:	**Weight:**	**Hair Color:**	**Eye Color:**	**Work Phone:**	
Company Name:	**Contract Exp Date:**	**Contract Number:**			
1. COMMAND ACCESS REQUEST					
☐ New Access	☐ Access Modification	☐ Non-CAC Contractor			
2. REASON FOR BADGE ISSUANCE					
☐ Initial Issue	☐ Renewal	☐ Replacement			
EXTERNAL BUILDING ACCESS:					
External Building(s), Days, and Time for access(EX: 455, Mon-Fri, 0600-1800)					
RESTRICTED SPACE(s) ACCESS REQUIRED:					
Building(s), Room Number, Days, Time for access(EX: 769, Room 188, 24 X 7)					
ONLY COMMAND APPOINTED AUTHORIZED PERSONNEL CAN SIGN REQUEST					
Authorizing Official: (Last Name, First and Middle Initial)	**Telephone Number:**				
Authorizing Official Signature: (N/A when emailed, verified by email from authorizing official)	**Date:**				

Privacy Act Statement

AUTHORITY: 5 U.S.C. 301; EO 12356; EO 9397

PRINCIPAL PURPOSE: To facilitate verification of a personnel security clearance for an individual applying for building access in connection with their livelihood or official duties.

ROUTINE USES; Information may be furnished to Federal, state, or local agencies for regulatory and law enforcement purposes.

DISCLOSURE: Voluntary; however, refusal to furnish requested information may result in inability to verify essential personal information and approve requested building pass application.

NAVSUPPACTMIDSOUTH 5530/7 (Rev.11-10)

RESOLUTION CONSULTANTS

CHAIN OF CUSTODY AND ANALYTICAL REQUEST RECORD

COC No.	Page of	
Project Name:	PO No.	Project No. Phase
Site Location:	**Sample Analysis Requested** (*Enter number of containers for each test*)	
CTO No. RC Task Order Manager:	(3)→	
Sampler/Site Phone#		
Lab Name: Turnaround Time(specify):		

Lab ID	Sample ID (sys_samp_code)	Location ID (sys_loc_code)	Date (mm/dd/yy)	Time (Military) (hhmm)	Matrix Code **(1)**	Sample Type **(2)**	Field Filtered (Y/N)	Total No. of Containers											Extra Volume for MS/MSD	HOLD

Field **Comments:**	*Lab* **Comments:**	**Sample Shipment and Delivery Details** Number of coolers in shipment:
Relinquished by (signature) Date Time 1	Received by (signature) Date Time 1	Samples Iced?(check) Yes_____ No_____ Method of Shipment:
2	2	Airbill No:
3	3	Date Shipped:

(1) AA=Ambient air, **AQ**=Air quality control, **ASB**=Asbestos, **CK**=Caulk, **DS**=Storm drain sediment, **GS**=Soil gas, **IC**=IDW Concrete, **IDD**=IDW Solid, **IDS**=IDW soil, **IDW**=IDW Water, **LF**=Free Product, **MA**=Mastic, **PC**=Paint Chips, **SC**=Cement/Concrete, **SE**=Sediment, **SL**=Sludge, **SO**=Soil, **SQ**=Soil/Solid quality control, **SSD**=Subsurface sediment, **SU**=Surface soil (<6 in), **SW**=Swab or wipe, **TA**=Animal tissue, **TP**=Plant tissue, **TQ**=Tissue quality control, **WG**=Ground water, **WL**=Leachate, **WO**=Ocean water, **WP**=Drinking water, **WQ**=Water quality control, **WR**=Ground water effluent, **WS**=Surface water, **WU**=Storm water, **WW**=Waste water

(2) Sample Type: AB=Ambient Blk, **EB**=Equipment Blk, **FB**=Field Blk, **FD**=Field Duplicate Sample, **IDW**=Investigative-Derived Waste, **MIS**=Incremental Sampling Methodology, **N**=Normal Environmental Sample, **TB**=Trip Blk

(3) Preservative added: **HA**=Hydrochloric Acid, **NI**=Nitric Acid, **SH**=Sodium Hydroxide, **SA**=Sulfuric Acid, **ME**=Methanol, **SB**=sodium bisulfate, **ST**=Sodium Thiosulfate If **NO preservativ**e added leave blank **Rev**

Field Measurement of Dissolved Oxygen

Solubility of Oxygen in Water at Atmospheric Pressure1,2			
Temperature oC	Oxygen Solubility mg/L	Temperature oC	Oxygen Solubility mg/L
0.0	14.621	26.0	8.113
1.0	14.216	27.0	7.968
2.0	13.829	28.0	7.827
3.0	13.460	29.0	7.691
4.0	13.107	30.0	7.559
5.0	12.770	31.0	7.430
6.0	12.447	32.0	7.305
7.0	12.139	33.0	7.183
8.0	11.843	34.0	7.065
9.0	11.559	35.0	6.950
10.0	11.288	36.0	6.837
11.0	11.027	37.0	6.727
12.0	10.777	38.0	6.620
13.0	10.537	39.0	6.515
14.0	10.306	40.0	6.412
15.0	10.084	41.0	6.312
16.0	9.870	42.0	6.213
17.0	9.665	43.0	6.116
18.0	9.467	44.0	6.021
19.0	9.276	45.0	5.927
20.0	9.092	46.0	5.835
21.0	8.915	47.0	5.744
22.0	8.743	48.0	5.654
23.0	8.578	49.0	5.565
24.0	8.418	50.0	5.477
25.0	8.263		

1. The table provides three decimals to aid interpolation

2. Under equilibrium conditions, the partial pressure of oxygen in air-saturated water is equal to that of the oxygen in water saturated

Well Construction Form

Facility/Project Name:

Well ID.:

Facility License Number:

Type of Well:
Ground Water Monitoring ☐
Piezometer ☐ Injection ☐
Other__________________

Date Well Installed:

Location of well relative to waste source:
Upgradient ☐ Downgradient ☐ Side-gradient ☐ Unknown ☐

Well Installed By:

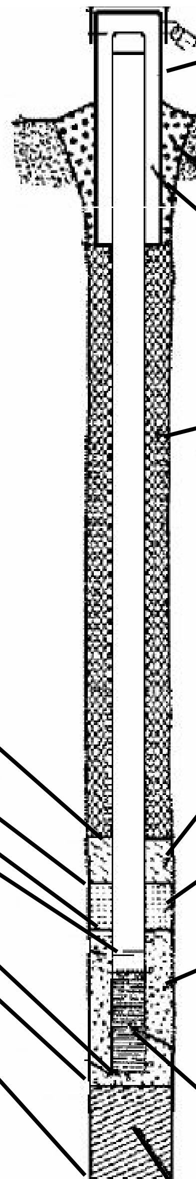
Well Driller License Number:

Geologist:

A. Protective pipe: ft. above grade
B. Well casing, top elevation: ft. MSL
C. Land Surface Elevation: ft. MSL
D. Surface seal, bottom: ft.below grade

12. USCS classification of soil near screen:
GP☐ GM ☐ GC ☐ GW ☐ SP ☐ SM ☐
SC☐ SW☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐
13. Sieve analysis attached? Yes ☐ No ☐
14. Drilling method used: Rotary ☐ HSA ☐
Other:
15. Drilling fluid used:
Water☐ Air ☐ Drilling Mud ☐ None ☐
16. Drilling additives used? Yes ☐ No ☐
Specify:
17: Source of water:

E. Bentonite seal: top ft. (depth)
F. Fine sand: top ft. (depth)
G. Filter pack: top ft. (depth)
H. Screen joint top: ft. (depth)
I. Well bottom: f t. (depth)
J. Filter pack: bottom ft. (depth)
K. Borehole: bottom . ft.(depth)
Borehole diameter: in.



1. Cap and lock? ☐ Yes ☐ No
2. Protective cover pipe:
   a. Inside diameter: in.
   b. Length: ft.
   c. Material: *Steel* ☐ *Other*
3. Surface seal: *Bentonite* ☐ *Concrete* ☐
   Other:
4. Material blw. well casing and protective pipe:
   Bentonite ☐ *Annular space seal* ☐
   Other:
5. Annular space seal: *(Manufacturer name)*
   a. Granular bentonite☐
   b. Bentonite/Cement slurry ☐
   % bentonite ……. Bentonite/cement grout ☐
   Lbs/gal mud weight … bentonite slurry ☐
   c. How installed: *Tremie* ☐ *Tremie pumped* ☐
   Gravity☐
6. Bentonite seal: *(Manufacturer, product name)*
   Bentonite granules ☐
   ☐ *¼ in.* ☐ *3/8 in.* ☐ *½ in.* *Bentonite pellets* ☐
   Other:
7. Fine sand material: *(Manufacturer, product name, mesh size)*
   Volume added: ft^3
8. Filter pack material: *(Manufacturer, product name, mesh size)*
   Volume added: ft^3
9. Well casing: Flush-threaded Sch 40 PVC☐
   Flush-threaded Sch 80 PVC☐
   Other:
10. Screen material:
   a. Screen type: factory cut ☐ continuous slot ☐
   Other:
   b. Manufacturer:
   c. Slot size: 0. in.
   d. Slotted length: ft.
11. Backfill material: *or* None ☐

CERTIFICATION:
I hereby certify that the information on this form is true and correct to the best of my knowledge:

____
(Signature)

____
(Company Name)

Appendix C
Standard Operating Procedures

Standard Operating Procedure SOP-3-01 (MS)
Utility Clearance

1.0 PURPOSE

This standard operating procedure (SOP) describes the process for determining the presence of subsurface utilities and other cultural features at locations where planned site activities involve the physical disturbance of subsurface materials. The procedure applies to the following activities: soil gas surveying, excavating, trenching, borings and installation of monitoring, injection, and extraction wells, use of soil recovery or slide-hammer hand augers, and all other intrusive sampling activities. The primary purpose of the procedure is to minimize the potential for damage to underground utilities and other subsurface features, which could result in physical injury, disruption of utility service, or disturbance of other subsurface cultural features.

If there are applicable procedures from Resolution Consultants, State and/or Federal entities that are not addressed in this SOP, those procedures may be added as an appendix to the project specific Sampling and Analysis Plan.

2.0 SCOPE

This procedure shall serve as a management-approved professional guidance and is consistent with protocol in the Uniform Federal Policy-Quality Assurance Project Plan (DoD 2005). As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment during unforeseen circumstances. Deviations from this procedure while planning or executing planned activities must be approved by either the Contract Task Order (CTO) Manager or the Quality Assurance (QA) Manager, and documented.

3.0 DEFINITIONS

3.1 Utility

For this procedure, a utility is defined as a manmade underground line or conduit, cable, pipe, vault or tank that is, or was, used for the transmission of material or energy (e.g., gas, electrical, telephone, steam, water or sewage, product transfer lines, or underground storage tanks).

3.2 As-Built Plans

As-built plans are plans or blueprints depicting the locations of structures and associated utilities on a property.

3.3 One-Call

The Utility Notification Center is the one-call agency for nationwide ‘call before you dig’ activities. The Utility Notification Center is open 24 hours a day, and accepts calls from anyone planning to dig. The phone number 811 is the designated call before you dig phone number for Tennessee that directly connects you to your local one call center. Additional information can be found at www.call811.com/.

Calling before you dig ensures that any publicly owned underground lines will be marked, so that you can dig around them safely. Having the utility lines marked not only prevents accidental damage to the lines, but prevents property damage and personal injuries that could result in breaking a line.

The following information will need to be provided when a call is placed to One-Call:

- Your name, phone number, company name (if applicable), and mailing address
- What type or work is being completed
- Who the work is being completed for
- The county and city the work is taking place in
- The address or the street where the work is taking place
- Marking instructions, (specific instructions as to where the work is taking place)

Under normal circumstances it takes between 2 days to 5 days from the time you call (not counting weekends or holidays) to have the underground lines marked. Because these laws vary from state to state, exactly how long it will take depends on where your worksite is located. You will be given an exact start time and date when your locate request is completed, which will comply with the laws in your area.

In the event of an emergency (any situation causing damage to life or property, or a service outage), lines can be marked sooner than the original given time if requested.

3.4 Toning

Toning is the process of surveying an area utilizing one or more surface geophysical methods to determine the presence or absence of underground utilities. Typically, toning is conducted after identifying the general location of utilities and carefully examining all available site utility plans. Each location is marked according to the type of utility being identified. In addition, areas cleared by toning are flagged or staked to indicate that all identified utilities in a given area have been toned. Toning is commonly conducted by the Utility Notification Center; however, private utility locating services are required in instances where the Utility Notification Center will not enter a subject property, suspect utility lines not included by the Utility Notification Center may be present on the property, or utility maps or site personnel with utility information are not available.

4.0 RESPONSIBILITIES

The CTO Manager, or designee, is responsible for verifying that these utility locating procedures are performed prior to the initiation of active subsurface exploration. The CTO Manager is responsible for ensuring that all personnel involved in sampling and/or testing shall have the appropriate education, experience, and training to perform their assigned tasks.

QA Manager or Technical Director is responsible for ensuring overall compliance with this procedure.

The onsite Field Manager (FM) is responsible for planning utility clearance and for locating and marking underground utilities according to this procedure.

Field personnel are responsible for the implementation of this procedure.

5.0 PROCEDURES

Follow the following steps at all sites where subsurface exploration will include excavations, drilling, or any other subsurface investigative method that could damage utilities at a site. In addition to the steps outlined below, always exercise caution while conducting subsurface exploratory work.

5.1 Prepare Preliminary Site Plan

Prepare a preliminary, scaled site plan depicting the proposed exploratory locations as part of the work plan. Include as many of the cultural and natural features as practical in this plan.

5.2 Review Background Information

Search existing plan files to review the as-built plans to identify the known location of utilities at the site. Plot the locations of utilities identified onto a preliminary, scaled site plan. Inform the CTO Manager if utilities lie within close proximity to a proposed exploration or excavation location. The CTO Manager will determine if it is necessary to relocate proposed sampling or excavation locations.

Include the utility location information gathered during investigation (e.g., remedial investigation or remedial site evaluation) work in the project design documents for removal or remedial actions. In this manner, information regarding utility locations collected during implementation of a CTO can be shared with the other contractors during implementation of a particular task order. In many instances, this will help to reduce the amount of additional geophysical surveying work the other contractor may have to perform.

Conduct interviews with onsite and facility personnel familiar with the site to obtain additional information regarding the known and suspected locations of underground utilities. In addition, if appropriate, contact shall be made with local utility companies to request their help in locating underground lines. Pencil in the dimensions, orientation, and depth of utilities, other than those identified on the as-built plans, at their approximate locations on the preliminary plans. Enter the type of utility, the personnel who provided the information, and the date the information was provided into the field log.

During the pre-fieldwork interviewing process, the interviewer will determine which site personnel should be notified in the event of an incident involving damage to existing utilities. Record this information in the field logbook with the corresponding telephone numbers and addresses.

5.3 Site Visit — Locate Utilities — Toning

The Resolution Consultants FM will complete and submit a dig permit, provided in Attachment 1, to the NSA Mid-South environment point of contact at least 21 business days in advance of the site access to initiate the utility clearance process for all intrusive sampling locations. The 15 business days will allow the Base Operations Support contractor to mark Navy utilities. In addition, the Resolution Consultants FTL will contact the one-call utility locator service at least 7 days prior to commencement of field work to complete a utility clearance ticket for the areas under investigation.

Utilities that are identified in the field, but not shown or incorrectly located on the work approval documentation, will be marked directly on the document and returned to the NSA Mid-South point of contact for inclusion in the Geographic Information System database.

Prior to the initiation of field activities, the field task manager or similarly qualified staff personnel shall visit the site and note existing structures and evidence of associated utilities, such as fire hydrants, irrigation systems, manhole and vault box covers, standpipes, telephone switch boxes, free-standing light poles, gas or electric meters, pavement cuts, and linear depression. Compare notes of the actual site configuration to the preliminary site plan. Note deviations in the field logbook and on the preliminary site plan. Accurately locate or survey and clearly mark with stakes, pins, flags, paint, or other suitable devices all areas where subsurface exploration is proposed. These areas shall correspond with the locations drawn on the preliminary site plan.

Following the initial site visit by the FM, Utility One Call or a subcontracted utility locator will locate, identify, and or/tone all utilities in the areas slated for investigation. The locator should utilize appropriate sensing equipment to attempt to locate utilities that might not have appeared on the as-built plans. This may involve the use of surface geophysical methods. Use other appropriate surface geophysical methods, such as Ground Penetrating Radar, if non-metallic cultural features are likely to be present at the site. Proposed drilling/excavation areas should be clearly marked on the ground before the utility locator enters the property so locations can be cleared and utilities appropriately marked relative to proposed investigation areas. Any utilities identified on the site that haven't been previously noted on site plans should be noted and transferred for subsequent reporting.

The FM shall refer to the site-specific health and safety plan to determine the safe distance to maintain from the known or suspected utility. It may be necessary to relocate proposed exploration or excavation areas. If this is required, the FM or a similarly qualified individual shall relocate them and clearly mark them using the methods described above. Completely remove the markings at the prior location. Plot the new locations on the site plan and delete the prior locations from the plan. In all proposed drilling instances, a hand auger or non-mechanical probing device (rebar, pipe, etc.) should be used to verify the absence of utilities.

5.4 Prepare Site Plan

Prior to the initiation of field activities, draft a final site plan that indicates the location of subsurface exploration areas and all known or suspected utilities present at the site. Provide copies of this site plan to the Navy Technical Representative (NTR), the CTO Manager, and the subcontractor who is to conduct the subsurface exploration/excavation work. Review the site plan with the NTR to verify its accuracy prior to initiating subsurface sampling activities.

6.0 RECORDS

Keep a bound field logbook detailing all utility locating procedures. The logbook will describe any changes and modifications made to the original investigation/exploration plan. Ticket reference numbers provided by Utility One Call should be maintained with the field records.

7.0 HEALTH AND SAFETY

Field and subcontractor personnel shall review and adhere to the site-specific health and safety plan prior to proceeding with any subsurface excavation activities.

8.0 REFERENCES

Department of Defense, United States (DoD). 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U.S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf

9.0 ATTACHMENTS

Attachment 1: Excavation Permit Request, Naval Support Activity Mid-South

Attachment 1

Excavation Permit Request, Naval Support Activity Mid-South

Standard Operating Procedure SOP-3-02

Field Logbooks

1.0 PURPOSE

This standard operating procedure describes the activities and responsibilities pertaining to the identification, use, and control of logbooks and associated field data. If there are procedures from Resolution Consultants, state and/or federal that are not addressed in this Standard Operating Procedure (SOP) and are applicable to logbooks, then those procedures may be added as an appendix to the project-specific Sampling and Analysis Plan.

2.0 SCOPE

This procedure shall serve as management-approved professional guidance and is consistent with protocol in the Uniform Federal Policy-Quality Assurance Project Plan Appendix A Section 1.4 *Field Documentation SOPs* (DoD, 2005). As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment during unforeseen circumstances. Deviations from this procedure while planning or executing planned activities must be approved by either the Contract Task Order (CTO) Manager or the Quality Assurance (QA) Manager, and documented.

3.0 DEFINITIONS

3.1 Logbook

A logbook is a bound field notebook with consecutively numbered, water-repellent pages that is clearly identified with the name of the relevant activity, the person assigned responsibility for maintenance of the logbook, and the beginning and ending dates of the entries.

3.2 Data Form

A data form is a predetermined format utilized for recording field data that may become, by reference, a part of the logbook (e.g., soil boring logs, trenching logs, surface soil sampling logs, groundwater sample logs, and well construction logs are data forms).

4.0 RESPONSIBILITIES

The CTO Manager, or designee, is responsible for determining which team members shall record information in field logbooks and for obtaining and maintaining control of the required logbooks. The CTO Manager, or designee, shall review the field logbook on at least a monthly basis. The CTO Manager, or designee, is responsible for reviewing logbook entries to determine compliance with this procedure and to ensure that the entries meet the project requirements.

A knowledgeable individual such as the Field Manager, CTO Manager, or QA Manager shall perform a technical review of each logbook at a frequency commensurate with the level of activity (weekly is suggested, or, at a minimum, monthly). Document these reviews by the dated signature of the reviewer on the last page or page immediately following the material reviewed.

The Field Manager is responsible for ensuring that all project field staff follows these procedures and that the logbook is completed properly and daily. The Field Manager is also responsible for submitting copies to the CTO Manager, who is responsible for filing them and submitting a copy to the Navy (if required by the CTO Statement of Work).

The logbook user is responsible for recording pertinent data into the logbook to satisfy project requirements and for attesting to the accuracy of the entries by dated signature. The logbook user is also responsible for safeguarding the logbook while having custody of it.

Field personnel are responsible for the implementation of this procedure.

5.0 PROCEDURE

The field logbook serves as the primary record of field activities. Make entries chronologically and in sufficient detail to allow the writer or a knowledgeable reviewer to reconstruct the applicable events. Store the logbook in a clean location and use it only when outer gloves used for personal protective equipment (PPE) have been removed.

Individual data forms may be generated to provide systematic data collection documentation. Entries on these forms shall meet the same requirements as entries in the logbook and shall be referenced in the applicable logbook entry. Individual data forms shall reference the applicable logbook and page number. At a minimum, include names and collection times of all samples collected in the logbook even if they are recorded elsewhere.

Enter field descriptions and observations into the logbook, as described in Attachment 1, using indelible black ink.

Typical information to be entered includes the following:

- Dates (month/day/year) and times (military) of all onsite activities and entries made in logbooks/forms

- Site name and description
- Site location by city, county, and longitude and latitude, if warranted
- Weather conditions, including approximate temperature
- Fieldwork documentation, including site entry and exit times
- Descriptions of, and rationale for, approved deviations from the work plan (WP) or field sampling plan
- Field instrumentation readings
- Names, job functions, and organizational affiliations of personnel onsite
- Photograph references
- Site sketches and diagrams made onsite
- Identification and description of sample morphology, collection locations and sample numbers as described in SOP 3-03, *Sample Labeling and Chain-of-Custody Procedures*
- Sample collection information, including dates (month/day/year) and times (military) of sample collections, sample collection methods and devices, station location numbers, sample collection depths/heights, sample preservation information, sample pH (if applicable), analysis requested (analytical groups), etc., as well as chain-of-custody (COC) information such as sample identification numbers cross-referenced to COC sample numbers
- Sample naming convention
- Field quality control (QC) sample information
- Site observations, field descriptions, equipment used, and field activities accomplished to reconstruct field operations

- Meeting information
- Important times and dates of telephone conversations, correspondence, or deliverables
- Field calculations
- PPE level
- Calibration records
- Contractor and subcontractor information (address, names of personnel, job functions, organizational affiliations, contract number, contract name, and work assignment number)
- Equipment decontamination procedures and effectiveness
- Laboratories receiving samples and shipping information, such as carrier, shipment time, number of sample containers shipped, and analyses requested
- User signatures

The logbook shall reference data maintained in other logs, forms, etc. Correct entry errors by drawing a single line through the incorrect entry, then initialing and dating this change. Enter an explanation for the correction if the correction is more than for a mistake.

At least at the end of each shift, the person making the entry shall sign or initial each entry or group of entries. Enter logbook page numbers on each page to facilitate identification of photocopies. If a person's initials are used for identification, or if uncommon acronyms are used, identify these on a page at the beginning of the logbook.

6.0 RECORDS

Retain the field logbook as a permanent project record. If a particular CTO requires submittal of photocopies of logbooks, perform this as required.

7.0 HEALTH AND SAFETY

In order to keep the logbook clean, store it in a clean location and use it only when outer gloves used for PPE have been removed.

8.0 REFERENCES

Department of Defense, United States (DoD). 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U.S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/-ufp_qapp_v1_0305.pdf.

9.0 ATTACHMENTS

Attachment 1: Description of Logbook Entries

Attachment 1

Description of Logbook Entries

Logbook entries shall contain the following information, as applicable, for each activity recorded. Some of these details may be entered on data forms, as described previously, in lieu of recording in the logbook.

Name of Activity	For example, Groundwater Sampling, Carbon Substrate Injections, Aquifer Testing, Etc.
Task Team Members and Equipment	Name all members on the field team involved in the specified activity. List equipment used by serial number or other unique identification, including calibration information.
Activity Location	Indicate location of sampling area as indicated in the field sampling plan.
Weather	Indicate general weather and precipitation conditions.
Level of PPE	Record the level of PPE (e.g., Level D).
Methods	Indicate method or procedure number employed for the activity.
Sample Name	Indicate the unique name associated with the physical samples. Identify QC samples.
Sample Type and Volume	Indicate the medium, container type, preservative, and the volume for each sample.
Time and Date	Record the time and date when the activity was performed (e.g., 0830/08/OCT/89). Use the 24-hour clock for recording the time and two digits for recording the day of the month and the year.
Analyses	Indicate the appropriate code for analyses to be performed on each sample, as specified in the WP.
Field Measurements	Indicate measurements and field instrument readings taken during the activity. If this information is recorded on a field form, the logbook should reference it, as appropriate.
Chain of Custody and Distribution	Indicate chain-of-custody information for each sample collected and indicate to whom the samples are transferred and the destination.
References	If appropriate, indicate references to other logs or forms, drawings, or photographs employed in the activity.
Narrative (including time and location)	Create a factual, chronological record of the team's activities throughout the day including the time and location of each activity. Include descriptions of general problems encountered and their resolution. Provide the names and affiliations of non-field team personnel who visit the site, request changes in activity, impact the work schedule, request information, or observe team activities. Record any visual or other observations relevant to the activity, the contamination source, or the sample itself. It should be emphasized that logbook entries are for recording data and chronologies of events. The logbook author must include observations and descriptive notations, taking care to be objective and recording no opinions or subjective comments unless appropriate.
Recorded by	Include the signature of the individual responsible for the entries contained in the logbook and referenced forms.

Standard Operating Procedure SOP-3-03A
Sample Labeling and Chain of Custody Procedures

Sample Labeling and Chain of Custody Procedures
Procedure 3-03A

1.0 Purpose and Scope

1.1 The purpose of this standard operating procedure is to establish standard protocols for all field personnel for use in maintaining field and sampling activity records, labeling samples, ensuring that proper sample custody procedures are utilized, and completing chain-of-custody/analytical request forms.

1.2 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review.

2.0 Safety

Not applicable

3.0 Definitions

3.1 Logbook

A logbook is a bound field notebook with consecutively numbered, water-repellent pages that is clearly identified with the name of the relevant activity, the person responsible for maintenance of the logbook, and the beginning and ending dates of the entries.

3.2 Chain-of-Custody

Chain-of-custody (COC) is documentation of the process of custody control. Custody control includes possession of a sample from the time of its collection in the field to its receipt by the analytical laboratory, and through analysis and storage prior to disposal.

4.0 Training and Qualifications

4.1 The **CTO Manager**, or designee, is responsible for determining which team members shall record information in the field logbook and for checking sample logbooks and COC forms to ensure compliance with these procedures. The **CTO Manager**, or designee, shall review COC forms at the completion of each sampling event.

4.2 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.

4.3 The **Field Manager** is responsible for ensuring that all field equipment is decontaminated according to this procedure.

4.4 The **Project Chemist**, or designee, is responsible for verifying that the COC/analytical request forms have been completed properly and match the sampling and analytical plan. The **Project Chemist**, or designee, is responsible for notifying the laboratory, data managers, and data validators in writing if analytical request changes are required as a corrective action. These small changes are different from change orders, which involve changes to the scope of the subcontract with the laboratory and must be made in accordance with a respective contract.

4.5 All **Field Personnel** are are responsible for recording pertinent data onto the COC forms to satisfy project requirements and for attesting to the accuracy of the entries by dated signature.

5.0 Procedure

This procedure provides standards for labeling the samples, documenting sample custody, and completing COC/analytical request forms. The standards presented in this section shall be followed to ensure that samples collected are maintained for their intended purpose and that the conditions encountered during field activities are documented.

5.1 Sample Labeling

Affix a waterproof sample label with adhesive backing to each individual sample container. Record the following information with a waterproof marker on each label:

- Project name or number (optional)
- COC sample number
- Date and time of collection
- Sampler's initials
- Matrix (optional)
- Sample preservatives (if applicable)
- Analysis to be performed on sample (This shall be identified by the method number or name identified in the subcontract with the laboratory)

These labels may be obtained from the analytical laboratory or printed from a computer file onto adhesive labels.

5.2 Custody Procedures

For samples intended for chemical analysis, sample custody procedures shall be followed through collection, transfer, analysis, and disposal to ensure that the integrity of the samples is maintained. A description of sample custody procedures is provided below.

Sample Collection Custody Procedures

According to the EPA guidelines, a sample is considered to be in custody if one of the following conditions is met:

- It is in one's actual physical possession or view
- It is in one's physical possession and has not been tampered with (i.e., it is under lock or official seal)
- It is retained in a secured area with restricted access
- It is placed in a container and secured with an official seal such that the sample cannot be reached without breaking the seal

Place custody seals on shipping coolers (and sample jars, if required) if the cooler/container is to be removed from the sampler's custody. Place a minimum of two custody seals in such a manner that they must be broken to open the containers or coolers. Label the custody seals with the following information:

- Sampler's name or initials
- Date and time that the sample/cooler was sealed

These seals are designed to enable detection of sample tampering. An example of a custody seal is shown in Attachment 1.

Field personnel shall also log individual samples onto COC forms (carbon copy or computer generated) when a sample is collected. These forms may also serve as the request for analyses. Procedures for completing these forms are discussed in Section 0, indicating sample identification number, matrix, date and time of collection, number of containers, analytical methods to be performed on the sample, and preservatives added (if any). The samplers will also sign the COC form signifying that they were the personnel who collected the samples. The COC form shall accompany the samples from the field to the laboratory. When a cooler is ready for shipment to the analytical laboratory, the person delivering the samples for transport will sign and indicate the date and time on the accompanying COC form. One copy of the COC form will be retained by the sampler and the remaining copies of the COC form shall be placed inside a self-sealing bag and taped to the inside of the cooler. Each cooler must be associated with a unique COC form. Whenever a transfer of custody takes place, both parties shall sign and date the accompanying carbon copy COC forms, and the individual relinquishing the samples shall retain a copy of each form. One exception is when the samples are shipped; the delivery service personnel will not sign or receive a copy because they do not open the coolers. The laboratory shall attach copies of the completed COC forms to the reports containing the results of the analytical tests. An example COC form is provided in Attachment 2.

5.3 Completing COC/Analytical Request Forms

COC form/analytical request form completion procedures are crucial in properly transferring the custody and responsibility of samples from field personnel to the laboratory. This form is important for accurately and concisely requesting analyses for each sample; it is essentially a release order from the analysis subcontract.

Attachment 2 is an example of a completed COC/analytical request form that may be used by field personnel, with box numbers identified and discussed in text below. Multiple copies may be tailored to each project so that much of the information described below need not be handwritten each time. Each record on the form (Attachment 2) is identified with a bold number corresponding to the instructions given below.

1. Record the project name, site location.
2. Record the site location, including the state.
3. Record the Contract Task Order number
4. Record the Resolution Consultants Task Order Manager
5. Record the sampler/site phone or cell number (if applicable).
6. Record the laboratory name where the samples were sent.
7. Record the requested turnaround time, in days. If a specific turnaround time is required to meet project objectives, but was not indicated on the laboratory service request form submitted to the purchasing department, the sampler, project manager, or site manager should contact the purchasing department so the laboratory contract can be modified.
8. Record the COC number that is defined by the sampler and should be unique throughout the project's history. An example would be to use the sampler's initials followed by the data. If multiple custodies are generated on a given day, use a unique sequential identifier. Example: CRC040105A, CRC040105B
9. Record the purchase order number provided by the purchasing department.
10. Record the page and total number of COC forms used in a shipment.
11. Record the project, and phase applicable to the sampling task.
12. Record the two-character code corresponding to the *chemical* preservation type, which is found on the bottom of the COC form. If no chemical preservation was added to the sample, the field should be left blank. Temperature preservation need not be documented at this location, but will be indicated elsewhere on the COC form (see 33).

13. List the requested analysis. Whenever possible, list the corresponding analytical method. (e.g., VOCs, 8260).

14. For Lab identification use only.

15. Record the full *unique* sample identification as detailed in the Site's Sampling and Analysis Plan.

16. Record the location identification, which is a shortened ID used for presentation and mapping, as detailed in the Site's Sampling and Analysis Plan.

17. Record the sample date using the format mm/dd/yy.

18. Record the sample time using the military format of hhmm.

19. Record the matrix code of the sample, which is located at the bottom of the COC form. The matrix code is a crucial element of the Navy's data management system. For simplicity, only typical matrix codes are listed on the bottom COC form, but below is a complete listing of all applicable Navy matrix codes:

Table 1
Navy Matrix Codes

Matrix Code	Matrix Code Description	Matrix Code	Matrix Code Description
AA	Ambient air	RK	Rock
AC	Composite air sample	SB	Bentonite
AD	Air - Drilling	SBS	Sub-surface soil (> 6")
AIN	Integrated air sample (under sample form of gas)	SC	Cement/Concrete
AQ	Air quality control matrix	SD	Drill cuttings — solid matrix
AQS	Aqueous	SE	Sediment
ASB	Asbestos	SEEP	SEEP
ASBF	Asbestos-Fibrous	SF	Filter sand pack
ASBNF	Asbestos-Non-Fibrous	SJ	Sand
AVE	Air-Vapor extraction, effluent	SK	Asphalt
AX	Air sample from unknown origin	SL	Sludge
BK	Brick	SM	Water filter (solid material used to filter water)
BS	Brackish sediment	SN	Miscellaneous solid/building materials
CA	Cinder ash	SO	Soil
CK	Caulk	SP	Casing (PVC, stainless steel, cast iron, iron pipe
CN	Container	SQ	Soil/Solid quality control matrix
CR	Carbon (usually for a remediation system)	SS	Scrapings
DF	Dust/Fallout	SSD	Subsurface sediment
DR	Debris/rubble	STKG	Stack gas
DS	Storm drain sediment	STPM	Stripper Tower Packing Media
DT	Trapped debris	SU	Surface soil (less than 6 inches)
EF	Emissions flux	SW	Swab or wipe
EW	Elutriate water	SZ	Wood
FB	Fibers	TA	Animal tissue
FL	Forest litter	TP	Plant tissue
GE	Soil gas effluent — stack gas (from system)	TQ	Tissue QC
GI	Soil gas influent (into system)	TX	Tissue
GL	Headspace of liquid sample	UNK	Unknown
GQ	Gaseous or Headspace QC	W	Water (not groundwater, unspecified)
GR	Gravel	WA	Drill cuttings - aqueous mix
GS	Soil gas	WB	Brackish Water

Table 1
Navy Matrix Codes

Matrix Code	Matrix Code Description	Matrix Code	Matrix Code Description
GT	Grit	WC	Drilling water (used for well construction)
IC	IDW Concrete	WD	Well development water
IDD	IDW Solid	WF	Freshwater (not groundwater)
IDS	IDW soil	WG	Ground water
IDW	IDW Water	WH	Equipment wash water
IW	Interstitial water	WI	Ground water influent (into system)
LA	Aqueous phase of a multiphase liquid/soil	WL	Leachate
LF	Product (floating or free)	WM	Marine water
LQ	Organic liquid quality control matrix	WN	Pore water
MA	Mastic	WO	Ocean water
MO	Mortar	WP	Drinking water
MR	Marine sediment	WQ	Water for QC samples
MS	Metal shavings	WR	Ground water effluent (from system)
NS	Near-surface soil	WS	Surface water
PA	Paper	WT	Composite groundwater sample
PC	Paint Chips	WU	Storm water
PP	Precipitate	WW	Waste water
RE	Residue		

Field QC blanks will require matrix codes that identify the type of blank associated with parent sample. Aqueous field QC blanks are not automatically identified with a matrix code of "WQ," indicating a water quality control blank; they are only identified with a matrix code of "WQ" if the associated samples are also aqueous. Trip blanks, field blanks, and equipment rinsate blanks collected in association with ***soil*** samples will be identified with a matrix code of "SQ," even though the actual matrix is aqueous, because the blanks were collected to assess potential contamination imparted during decontamination activities or transport of ***soil*** samples.

20. Record the sample type code, which is located at the bottom of the COC form. The sample type is a crucial element of the EQuIS data management system. For simplicity, only typical sample type codes are listed on the bottom of the COC form, but below is a list of all applicable Navy field sample type codes:

Table 2
Navy Sample Type Codes

Sample Type Code	Sample Type Code Description
AB	Ambient condition blank
BIOCON	Bioassay control sample
BS	Blank spike
BSD	Blank spike duplicate
EB	Equipment blank
EBD	Equipment blank/rinsate duplicate
FB	Field blank
FD	Field duplicate
FS	Field spike
IDW	Purge and rinsate water
LB	Lab Blank

Table 2
Navy Sample Type Codes

Sample Type Code	Sample Type Code Description
LR	Lab Replicate
MB	Material blank
MIS	Multi-Incremental Sample
MS	Matrix spike
N	Normal (Regular)
PE	Performance evaluation
PURGE	Purge water sample
RD	Regulatory duplicate
SB	Source blank
SBD	Source blank duplicate
SCREEN	Screening Sample
SD	Matrix spike duplicate
SPLIT	Sample split
SRM	Standard reference material
TB	Trip Blank
TBD	Trip blank duplicate
TBR	Trip blank replicate

Field duplicate samples — Field duplicates will be identified using the format detailed in the Site's Sampling and Analysis Plan. However, field duplicates will also be differentiated from the parent sample on the chain-of-custody form. The parent sample will have a sample type code of "N," for normal environmental sample; while its duplicate will have a sample type code of "FD."

21. Record whether the sample is field filtered with a "Y" or not field filtered with an "N." If a project requires collecting samples for both total and dissolved constituents, the same sample and location ID is used for both (see 15 and 16); however, the sampler will indicate whether the sample is field filtered at this location on the COC form. This field <u>must</u> always be filled out; even when soil samples are collected (where "N" appropriately applies, in most cases).

22. Record the total number of containers that are submitted for all of the tests. This must add up to the total number of containers listed for each individual test in 23.

23. Record the number of containers for each test. Do not use Xs, rather indicate the number of containers submitted for each test listed in 14. For example, Sample 010MW007002 requires analysis for VOCs (8260), and SVOCs (8270). Record 3 under the VOC analysis and 2 under the SVOC (assuming 3 containers were submitted for VOCs and 2 were submitted for SVOCs). The total number of containers in this example is 5, which should be the total number of containers listed in 22. Extra containers submitted for matrix spike/matrix spike duplicates (MS/MSDs) will be appropriately recorded.

24. Indicate if extra sample volume was included for MS/MSD analysis using an "X." Samples to be used for MS/MSDs will use the same sample ID and location ID (see 15 and 16), but will be collected in triplicate, particularly for liquid samples, to ensure the analytical laboratory receives sufficient volume for the analyses.

25. Indicate if the samples should be held by the laboratory for future testing using an "X."

26. Record any field comments.

27. Reserved for laboratory comments.

28. Indicate the total number of coolers in each shipment. *Note*: When multiple coolers are submitted, each should contain a COC form.

29. Signature(s) of the person(s) relinquishing sample custody.

30. Signature(s) of the person(s) receiving sample custody.

31. Indicate whether the samples are iced, by checking the appropriate response.

32. Indicate the method of shipment (e.g., FedEx, hand-delivered, laboratory courier).

33. Record the airbill number when a commercial courier is used. This is particularly important when multiple coolers are sent in the same shipment or when the laboratory is sent the COC form in advance of receiving samples because it aids in tracking lost coolers.

34. Record the date the coolers were shipped.

COC forms tailored to each CTO can be drafted and printed onto multiple forms. This eliminates the need to rewrite the analytical methods column headers each time. It also eliminates the need to write the project manager, name, and number; QC Level; turnaround time; and the same general comments each time.

Complete one COC form per cooler. Whenever possible, place all volatile organic analyte vials into one cooler in order to reduce the number of trip blanks. Complete all sections and be sure to sign and date the COC form. One copy of the COC form must remain with the field personnel.

6.0 Records

The COC/analytical request form shall be faxed or emailed approximately daily to the Project Chemist, or designee for verification of accuracy. Following the completion of sampling activities, the sample logbook and COC forms will be transmitted to the CTO Manager for storage in project files. The original COC/analytical request form shall be submitted by the laboratory along with the data delivered. Any changes to the analytical requests that are required shall be made in writing to the laboratory. A copy of this written change shall be sent to the data validators and placed in the project files. The reason for the change shall be included in the project files so that recurring problems can be easily identified.

7.0 References and Attachments

Department of Defense, United States (DoD). 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/-fedfac/pdf/ufp_qapp_v1_0305.pdf.

Attachment 1: Chain-of-Custody Seal

Attachment 2: Generic Chain-of-Custody/Analytical Request Form

Author	Reviewer	Revisions (Technical or Editorial)
Tina Cantwell QA Officer	Ben Brantley Project Manager	Rev 0 — Initial Issue

Attachment 1
Chain-of-Custody Seal

EXAMPLE CHAIN-OF-CUSTODY SEAL

<table>
<tr><td rowspan="3">[LABORATORY]</td><td>SAMPLE NO.</td><td>DATE</td><td>SEAL BROKEN BY</td></tr>
<tr><td colspan="2">SIGNATURE</td><td>DATE</td></tr>
<tr><td colspan="3">PRINT NAME AND TITLE (Inspector, Analyst or Technician</td></tr>
</table>

Attachment 2
Example Chain-of-Custody/Analytical Request Form

RESOLUTION CONSULTANTS

CHAIN OF CUSTODY AND ANALYTICAL REQUEST RECORD		COC No. 7	Page of 9
Project Name:	1	PO No. 8	Project No. 10
Site Location:	2		Lab Name 11
Contract Task Order No.	3	Sample Analysis Requested (Enter number of containers for each test)	
Sampler/Site Phone#	4		
Send Results To:	5		
Data Shipping Address:	6		

Lab ID	Sample ID (sys_samp_code)	Location ID (sys_loc_code)	Date (mm/dd/yy)	Time (Military) (hhmm)	Matrix Code (1)	Sample Type (2)	Field Filtered (Y/N)	Total No. of Containers	12 13										Extra Volumen for MS/MSD	HOLD
14	15	16	17	18	19	20	21	22	23										24	25

Turnaround Time(specify): 26 **Final** _____ days **Email** (if applicable) _____ days

Deliverable(check): 27 Level 2_____ Level 3_____ Full/Level 4_____ TX TRRP-13_____

Field **Comments:** 28	*Lab* **Comments:** 29	**Sample Shipment and Delivery Details**
		Number of coolers in shipment: 30

Relinquished by (signature)	Date	Time	Received by (signature)	Date	Time	
						Samples Iced?(check) 33 Yes___ No___
1 31			1 32			Method of Shipment: 34
2			2			Airbill No: 35
3			3			Date Shipped: 36

(1) AA=Ambient air, **AQ**=Air quality control, **ASB**=Asbestos, **CK**=Caulk, **DS**=Storm drain sediment, **GS**=Soil gas, **IC**=IDW Concrete, **IDD**=IDW Solid, IDS=IDW soil, **IDW**=IDW Water, **LF**=Free Product, **MA**=Mastic, **PC**=Paint Chips, **SC**=Cement/Concrete, **SE**=Sediment, **SL**=Sludge, **SO**=Soil, **SQ**=Soil/Solid quality control, **SSD**=Subsurface sediment, **SU**=Surface soil (<6 in), **SW**=Swab or wipe, **TA**=Animal tissue, **TP**=Plant tissue, **TQ**=Tissue quality control, **WG**=Ground water, **WL**=Leachate, **WO**=Ocean water, **WP**=Drinking water, **WQ**=Water quality control, **WR**=Ground water effluent, **WS**=Surface water, **WU**=Storm water, **WW**=Waste water

(2) Sample Type: **AB**=Ambient Blk, **EB**=Equipment Blk, **FB**=Field Blk, **FD**=Field Duplicate Sample, **IDW**=Investigative Derived Waste, **MIS**=Incremental Sampling Methodology, **N**=Normal Environmental Sample, **PE**=Performance Eval., **TB**=Trip Blk

(3) Preservative added: **HA**=Hydrochloric Acid, **NI**=Nitric Acid, **SH**=Sodium Hydroxide, **SA**=Sulfuric Acid, **AA**=Ascorbic Acid, **HX**=Hexane, **ME**=Methanol, **SB**=sodium bisulfate, **ST**=Sodium Thiosulfate, If **NO preservative** added leave blank

Standard Operating Procedure SOP-03-04 (MS)

Sample Handling, Storage, and Shipping of Low Level Environmental Samples

1.0 PURPOSE

This Standard Operating Procedure (SOP) sets forth the methods for use by personnel engaged in handling, storing, and transporting low level environmental samples.

If there are procedures whether from Resolution Consultants, state and/or federal that are not addressed in this SOP and are applicable to sample handling, storage, and shipping, then those procedures may be added as an appendix to the project-specific Sampling and Analysis Plan.

2.0 SCOPE

In general, low-level environmental samples include drinking water, most groundwater and ambient surface water, soil, sediment, treated municipal and industrial wastewater effluent, biological specimens, and other samples not expected to be contaminated with high levels of hazardous materials. Samples collected from process wastewater streams, drums, bulk storage tanks, soil, sediment, or water samples from areas suspected of being highly contaminated may require shipment as dangerous goods and are not covered in this SOP, which is intended for handling and shipment of low-level environmental samples.

This procedure shall serve as management-approved professional guidance consistent with protocol in the Uniform Federal Policy-Quality Assurance Project Plan (DoD 2005). As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment during unforeseen circumstances. Deviations from this procedure while planning or executing planned activities must be approved by either the Contract Task Order (CTO) Manager or the Quality Assurance (QA) Manager, and documented.

3.0 DEFINITIONS

None.

4.0 RESPONSIBILITIES

The CTO Manager, or designee, and the laboratory Project Manager are responsible for identifying instances of non-compliance with this procedure and ensuring that future sample transport activities are in compliance with this procedure.

The Field Manager is responsible for ensuring that all samples are shipped according to this procedure. Field personnel are responsible for the implementation of this procedure. Personnel that are involved in packaging, shipping, and receipt of samples must be aware of

Department of Transportation (DOT) regulations, know when to apply them, and know what procedures are needed to support this application.

The QA Manager or Technical Director is responsible for ensuring that sample handling, storage, and transport activities conducted during all CTOs are in compliance with this procedure.

5.0 PROCEDURES

5.1 Handling and Storage

Environmental samples should be packaged prior to shipment using the following procedures:

1. Allow sufficient headspace in all bottles (except volatile organic analysis containers with a septum seal) to compensate for any pressure and temperature changes (approximately 1 percent of the volume of the container).

2. Ensure that the lids on all bottles are tight (will not leak).

3. Glass bottles should be wrapped in bubble wrap — preferably sealable bubble wrap sample bags, if available. Place bottles in separate and appropriately-sized polyethylene bags and seal the bags.

4. Select a sturdy cooler in good repair. Secure and tape the drain plug with fiber or duct tape inside and outside. Line the cooler with a large heavy-duty plastic bag.

5. Place cushioning/absorbent material in the bottom of the cooler, if available, and then place the containers in the cooler with sufficient space to allow for the addition of cushioning between the containers.

6. Put "blue ice" (or ice that has been "double bagged" in heavy-duty polyethylene bags and properly sealed) on top of and/or between the containers. Fill all remaining space between the containers with bubble wrap or other suitable absorbent material.

7. Securely fasten the top of the large garbage bag with packaging tape.

8. Place the completed Chain-of-Custody (COC) Record into a sealed plastic bag, and tape the bag to the inner side of the cooler lid.

9. Close the cooler and securely tape (preferably with fiber tape) the top of the cooler shut. COC seals should be affixed to opposing sides of the cooler within the securing tape so that the cooler cannot be opened without breaking the seal.

5.2 Shipping

Follow all appropriate DOT regulations (e.g., 49 Code of Federal Regulations, Parts 171-179) for shipment of air, soil, water, and other samples. Elements of these procedures are summarized in the following subsections.

5.2.1 Non-hazardous Materials Shipment

If the samples are suspected to be non-hazardous based on previous site sample results, field screening results, or visual observations, if applicable, then samples may be shipped as non-hazardous.

When a cooler is ready for shipment to the laboratory, prepare standard air bill paperwork for shipment of the samples to the laboratory. Write the shippers tracking/airbill number on the COC form. Place two copies of the COC form inside a self-sealing bag and tape it to the inside of the cooler. Seal the cooler with waterproof tape and label it with "Fragile," "This-End-Up" (or directional arrows pointing up), or other appropriate notices. Affix a label stating the destination (laboratory address) to each cooler. Personnel should be aware of carrier weight or other policy restrictions.

5.2.1 Hazardous Materials Shipment

Shipment of Hazardous Material is not covered in this SOP; all samples handled under this SOP are anticipated to be non-hazardous or not dangerous goods. The CTO Manager, or designee, is responsible for determining if samples collected during a specific field investigation meet the definitions for dangerous goods. If a sample is collected of a material that is listed in the Dangerous Goods List, Section 4.2, of International Air Transport Authority (IATA), then that sample must be identified, packaged, marked, labeled, and shipped according to the instructions given for that material. If the composition of the collected sample(s) is unknown, and the project leader knows or suspects that it is a regulated material (dangerous goods), the sample may not be offered for air transport. If the composition and properties of a waste sample or a highly contaminated soil, sediment, or water sample are unknown, or only partially known, the sample may not be offered for air transport.

6.0 RECORDS

Maintain records as required by implementing these procedures.

7.0 HEALTH AND SAFETY

Avoid lifting heavy coolers with back muscles; instead, use leg muscles or dollies.

Wear proper gloves, such as blue nitrile and latex, as defined in the site-specific project health and safety plan, when handling sample containers to avoid contacting any materials that may have spilled out of the sample containers.

8.0 REFERENCES

International Air Transport Authority (IATA). Dangerous Goods Regulations http://www.iata.org/whatwedo/cargo/dangerous_goods/Documents/DGR52-significant-changes.pdf

Department of Defense, United States (DoD). 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

9.0 ATTACHMENTS

None

Standard Operating Procedure SOP-3-05 (MS)
Investigation-Derived Waste Management

1.0 PURPOSE

The purpose of this procedure is to provide guidance for the minimization, handling, labeling, temporary storage, inventory, classification, and disposal of investigative derived waste (IDW) generated during all field activities, including:

- Personal protective equipment (i.e., gloves, Tyveks, spent respirators) and non-contaminated solid waste.
- Solid hazardous and non-hazardous waste (i.e., soil cuttings, drilling mud, contaminated equipment)
- Liquid hazardous and non-hazardous waste (i.e., purge/development water, rinse water from decontamination, free-phase product)

The waste handling procedures will vary according to project-specific and Facility requirements. Those specified in this SOP are unique to Naval Support Activity Mid-South in Millington, Tennessee. Additional procedures from Resolution Consultants, state and/or federal regulations that are not addressed in this Standard Operating Procedure (SOP) and that are applicable, may be added as an appendix to the project specific Sampling and Analysis Plan (SAP).

2.0 SCOPE

This procedure shall serve as management-approved professional guidance and is consistent with protocol in the Uniform Federal Policy-Quality Assurance Project Plan (DoD 2005). As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment during unforeseen circumstances. Deviations from this procedure while planning or executing planned activities must be approved by both the Contract Task Order (CTO) Manager and the Quality Assurance (QA) Manager or Technical Director, and documented.

Solid, liquid, and PPE waste will be characterized for disposal through the use of client knowledge, laboratory analytical data created from soil or groundwater samples gathered during the field activities, and/or composite samples from individual containers.

All waste generated during field activities will be stored, transported, and disposed of according to applicable state, federal, and local regulations. While no hazardous waste generation is expected, any that is classified as hazardous will be disposed of at a licensed treatment storage and disposal facility.

All waste-disposal shall be carefully coordinated with NSA Mid-South Public Works personnel and the facility receiving the waste. Facilities receiving waste have specific requirements. Waste characterization shall be conducted to support both applicable regulations and Facility requirements.

3.0 RESPONSIBILITY

The CTO Manager is responsible for overseeing and ensuring that the IDW is properly managed in accordance with this SOP and any other facility or project-specific planning documents.

The Field Team Leader is responsible for understanding, overseeing, and documenting all field activities related to the implementation of this SOP.

4.0 PROCEDURES FOR WASTE DISPOSAL

The following procedures are to be used for handling IDW at NSA Mid-South.

4.1 Soil and Mud Waste

Soil cuttings and drilling mud generated from drilling activities shall be collected in 55-gallon drums and staged next to the borehole/monitoring well until the conclusion of the drilling program. Drums shall be secured with bolt-on lids and labeled in accordance with this SOP. An inventory containing the source, volume, and description of generated soil/mud waste shall be logged in the field logbook. At the conclusion of the drilling program and consistent with recent RFI activities, NSA Mid-South Public Works personnel shall be contacted for access to SWMU 41 on the Southside of the facility where the soil waste will be thin-spread and temporarily staged while pending laboratory analysis. Straw bales will be placed around the soil placement area to ensure effective storm water controls. Soil and mud-waste should be spread to a thickness of 6-inches, after which one composite soil sample shall be collected for every 100 square feet of soil and submitted for total and toxicity characteristic leaching procedure (TCLP) analyses for the contaminants of concern. When placing soil cuttings and mud at SWMU 41, a minimum 60 foot buffer (100 feet is preferred) shall be made between the soil and top of the creek bank. The analytical data will be used to verify whether a potential exposure risk is posed and whether the soil meets the characteristic hazardous waste criteria. If the contaminants of concern are unknown or could be multiple, then samples shall be analyzed for a full analytical suite using both methods (total and TCLP). Soil waste generated shall be analyzed for the minimum constituents: TPH, VOCs, and TCLP-VOCs, and TCLP-RCRA Metals.

Following confirmation that no soil risk is posed by contaminants in the soil and it meets the non-hazardous criteria characteristics, the plastic sheeting will be removed, the soil will be seeded and covered with straw. The SWMU 41 soil disposal area is shown on Figure 1 (Attachment 1).

A sketch of sample locations shall be made in the field logbook and upon receipt of the analytical data, a summary table of any detected contaminants shall be created with the appropriated screening/regulatory standards for documenting the final disposition of the soil IDW. A hits-only summary table and analytical data should be provided to the Navy in the project-specific report.

In the rare event waste is deemed hazardous or poses a residential risk based on detected contaminants, it must be containerized and arranged for disposed at an off-site facility. Transportation and disposal of any waste shall be coordinated directly with NSA Mid-South Public Works personnel who will sign all applications and waste manifests. NSA Mid-South Public Works personnel that should be contacted with all waste disposal issues are the following:

Debbie Zanot (Hazardous Waste Coord.)	901-874-5368
Jim Heide (alternate)	901-874-5367

Should waste or waste water analysis indicate that the material must be disposed of as hazardous waste, disposal shall be coordinated with Debbie Zanot. Phone number is listed above.

4.2 Waste Water

Groundwater generated during monitoring well development, purging, and sampling has historically been released to the sanitary sewer after collecting waste profile data and authorization from the Millington Waste Water Treatment Plant. Typically, development/purge water is collected in totes, drums and/or portable storage tanks provided by the drilling contractor and then transferred to a larger holding tank provided by NSA Mid-South Public Works personnel. Public works personnel must be contacted in advance of sampling/drilling activities so holding tanks can be staged at the 1625 containment area. Any containers holding waste water awaiting analysis must be labeled, properly secured, and staged until analysis is complete and authorization granted by the City of Millington to discharge the waste water to the sewer.

Before waste water can be discharged to the sanitary sewer, the City of Millington waste water treatment plant requires that the water-waste be characterized and data evaluated for the contaminants of concern. One water sample shall be collected per holding tank and analyzed for the contaminants of concern. Fisher Arnold Inc. is subcontracted by the waste water treatment plant for data evaluation and discharge approval. Upon receipt of the analytical data, approval for discharge must be requested via email from Mr. Jim Cox at jlcox@fisherarnold.com. The request will contain the following information:

- Analytical data for contaminant(s) of concern
- Volume of proposed discharge
- Schedule of anticipated discharge

Upon approval for discharging waste water, water will be released to the sanitary sewer and Public Works personnel will be contacted for the removal and transport of the emptied holding tank(s) to their designated storage area. Discharge dates, volumes, and analytical data shall be retained with the project files and incorporated into the appropriate project-specific reports. All copies of correspondence between RC and City of Millington shall be forwarded to the Public Works Environmental Division Director and NSA POC. In the event water waste is considered hazardous or approval to discharge to the sanitary sewer is not permitted by the City of Millington, the waste is to remain staged until alternate treatment and/or disposal options are evaluated with NSA Mid-South personnel.

4.3 Personal Protective Equipment (PPE)

Therefore, PPE and non-media solid waste (i.e., empty bags, supply containers, trash) that is generated during investigation activities shall be placed in plastic garbage bags and disposed of in designated dumpsters at NSA Mid-South. In the event PPE is generated from contact with suspect hazardous liquid or solid waste it shall be labeled, secured in a 55-gallon drum, and appropriately disposed of pending the analytical results.

4.4 Soil Drum Handling

Soil and mud IDW shall be containerized using U.S. Department of Transportation-(DOT) approved drums. The drums shall be made of steel, have a 55-gallon capacity, be completely painted and have removable lids (i.e., United Nations Code 1A2 or 1H2). Lids must be able to securely closed. Recycled drums shall not be used for hazardous waste, polychlorinated byphenyls (PCBs) or other regulated shipments. For short-term storage of non-hazardous soil IDW, reconditioned drums are acceptable for use. Verify the integrity of the foam or rubber sealing ring located on the underside of some drum lids prior to sealing drums containing IDW liquids. If the ring is only partially attached to the drum lid, or if a portion of the ring is missing, select another drum lid with a sealing ring that is in sound condition.

To prepare IDW drums for labeling, wipe clean the outer wall surfaces and drum lids of all material that might prevent legible and permanent labeling. If potentially contaminated material adheres to the outer surface of a drum, wipe that material from the drum, and segregate the paper towel or rag used to remove the material with visibly soiled PPE and disposable sampling equipment. Label all IDW drums and place them on pallets for transport.

4.5 Drum Labeling

Two general conditions exist for labeling drums: 1) waste characteristics are known to be either hazardous or nonhazardous from previous studies or project-specific data; or 2) waste characteristics are unknown until additional data are obtained. In most cases waste generated in environmental investigations can be assumed to be non-hazardous; however, if waste is suspected to contain elevated contaminant mass based on staining, odors, or other indications, then the waste should be segregated and labeled while pending analysis followed with the below drum labeling instructions. In no case should waste be thin-spread at SWMU 41 (as discussed in Section 4.1) if there is any indication that contamination may be present in the waste.

The following labeling requirements shall be adhered to for nonhazardous waste containers that are generated and pending transportation/disposal:

- Description and SWMU/AOC originating location of waste (i.e., purge water, soil cuttings); include “awaiting analysis” in the description
- Contact information (i.e., contact name and telephone number)
- Date when the waste was first generated

The following information shall be placed on all hazardous waste labels:

- Description and originating location of waste (i.e., "SWMU name" and "purge water" or "soil cuttings"); include "awaiting analysis" in the description
- Generator information (i.e., name, address, contact telephone number)
- EPA identification number (supplied by on-site client representative)
- Date when the waste was first accumulated

If waste data is suspected of being contaminated then the drums should be staged and labeled with the words "waste characterization pending analysis" and the following information included on the label:

- Description and originating location of waste include "awaiting analysis" in the description
- Contact information (i.e., contact name and telephone number)
- Date when the waste was first accumulated

Once the waste has been characterized, the label should be changed as appropriate for a nonhazardous or hazardous waste. If the project-specific planning documents do not specify the sampling frequency, one composite sample shall be collected per set of drums generated at each monitoring well/soil boring.

Waste labels should be constructed of a weatherproof material and filled out with a permanent marker to prevent being washed off or becoming faded by sunlight. Waste labels shall be placed on the side of the container, since the top is more subject to weathering. However, when multiple containers are accumulated together, labels must also be placed on the top of the containers to facilitate organization and disposal.

4.6 Waste Accumulation On-Site

Solid, liquid, or PPE wastes generated during investigation activities that are classified as hazardous shall not be accumulated on-site longer than 90 days. All waste that is deemed as hazardous or drummed non-hazardous waste that requires off-site shipment, temporarily will be staged at Building 1694 while pending transport and disposal. Any waste requiring offsite disposal shall be coordinated with Ms. Debbie Zanot (ph. 901-874-5368), the NSA Mid-South hazardous waste coordinator. At a minimum, the following requirements for the hazardous waste storage area must be implemented:

- Proper hazardous waste signs shall be posted as required by any state or federal statutes that may govern the labeling of waste
- Secondary containment to contain spills
- Spill containment equipment must be available
- Fire extinguisher
- Adequate aisle space for unobstructed movement of personnel

RC will generate an inventory of all drums staged at 1694 at the conclusion of field activities and their classification (hazardous versus non-hazardous) and quantity will be provided to NSA Mid-South Public Works Environmental Division Director. Any transport of waste classified as hazardous will be conducted only by a state-certified hazardous waste hauler. Typically, the facility receiving any waste can coordinate a hauler to transport the waste. Shipped hazardous waste shall be disposed of in accordance with all RCRA/USEPA requirements. All waste manifests or bills of lading will be signed by the NSA Mid-South Public Works Environmental Division Director and copied to the project file.

5.0 REGULATORY REQUIREMENTS

The following federal and state regulations shall be used as resources for determining waste characteristics and requirements for waste storage, transportation, and disposal:

- Code of Federal Regulations (CFR), Title 40, Part 261
- CFR, Title 49, Parts 172, 173, 178, and 179

6.0 RECORDS

All containerized IDW shall be documented in the field logbook.

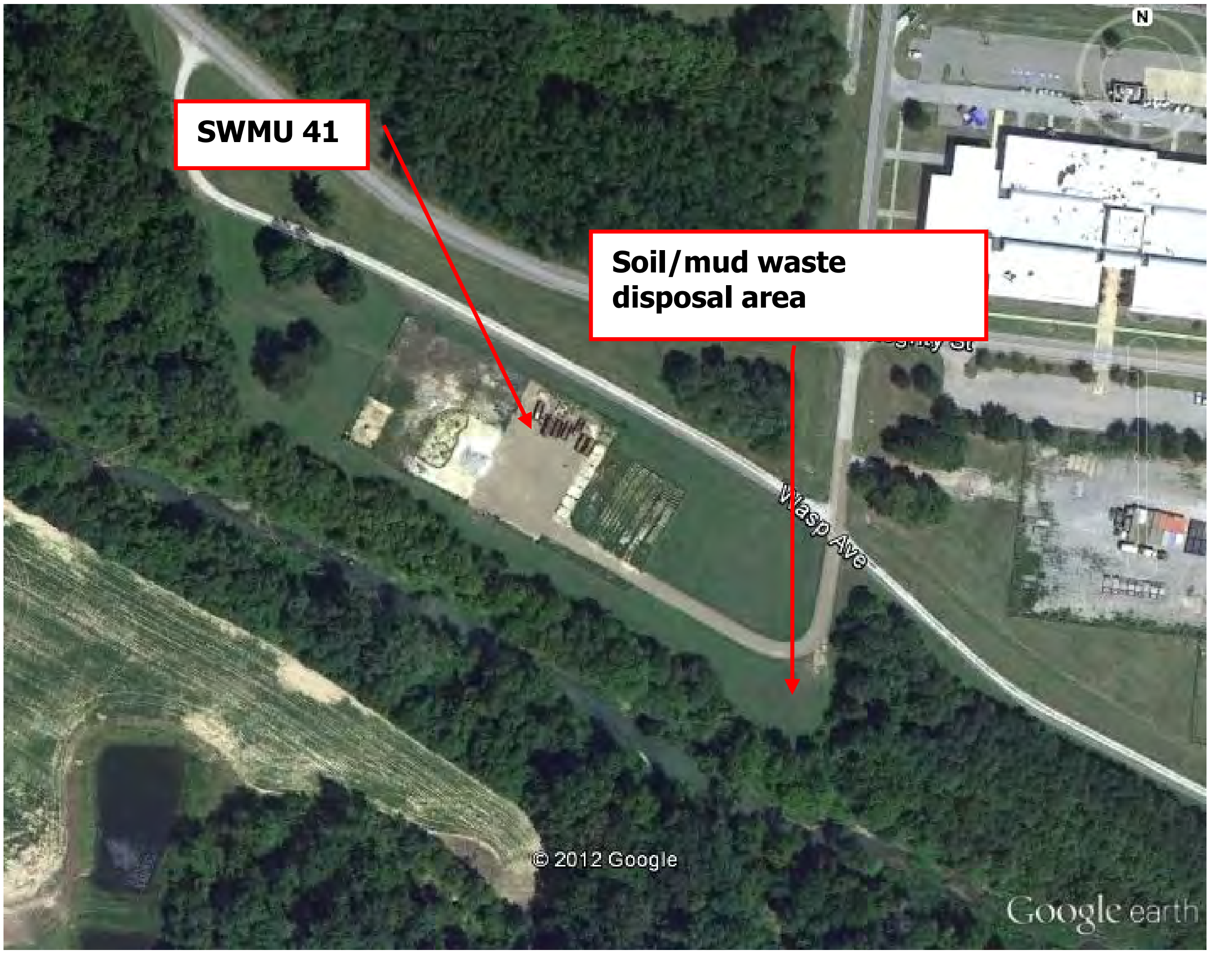
7.0 REFERENCES

Department of Defense, United States (DoD). 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf

Attachments

Attachment 1: Figure 1 — Soil/Mud Waste Disposal Area; Former SWMU 41 at NSA Mid-South Southside

Figure 1 — Soil/Mud Waste Disposal Area; Former SWMU 41 at NSA Mid-South Southside



Standard Operating Procedure SOP-3-06
Equipment Decontamination

1.0 PURPOSE

This standard operating procedure (SOP) describes methods of equipment decontamination for use during site activities by field personnel. If there are procedures from Resolution Consultants, state and/or federal that are not addressed in this SOP and are applicable to equipment decontamination, then those procedures may be added as an appendix to the project-specific Sampling and Analysis Plan (SAP).

2.0 SCOPE

This procedure shall serve as management-approved professional guidance for and is consistent with protocol in the Uniform Federal Policy-Quality Assurance Project Plan (DoD 2005). As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment during unforeseen circumstances. Deviations from this procedure while planning or executing planned activities must be approved by both the Contract Task Order (CTO) Manager and the Quality Assurance (QA) Manager.

3.0 DEFINITIONS

3.1 Logbook

A logbook is a bound field notebook with consecutively numbered, water-repellent pages that is clearly identified with the name of the relevant activity, the person assigned responsibility for maintenance of the logbook, and the beginning and ending dates of the entries.

4.0 RESPONSIBILITIES

The CTO Manager is responsible for identifying instances of non-compliance with this procedure and ensuring that decontamination activities comply with this procedure. The CTO Manager is responsible for ensuring that all personnel involved in equipment decontamination shall have the appropriate education, experience, and training to perform their assigned tasks.

The QA Manager or CTO Manager is responsible for ensuring overall compliance with this procedure. The Field Manager is responsible for ensuring that all field equipment is decontaminated according to this procedure. Field personnel are responsible for the implementation of this procedure.

5.0 PROCEDURES

Decontamination of equipment used in soil/sediment sampling, groundwater monitoring, well drilling and well development, as well as equipment used to sample groundwater, surface water, sediment, waste, wipe, asbestos, and unsaturated zone is necessary to prevent cross-contamination and to maintain the highest integrity possible in collected samples. Planning a decontamination program requires consideration of the following factors:

- The location where the decontamination procedures will be conducted
- The types of equipment requiring decontamination
- The frequency of equipment decontamination
- The cleaning technique and types of cleaning solutions appropriate to the contaminants of concern
- The method for containing the residual contaminants and wash water from the decontamination process
- The use of a quality control measure to determine the effectiveness of the decontamination procedure

The following subsection describes standards for decontamination, including the frequency of decontamination, cleaning solutions and techniques, containment of residual contaminants and cleaning solutions, and effectiveness.

5.1 Decontamination Area

Select an appropriate location for the decontamination area at a site based on the ability to control access to the area, the ability to control residual material removed from equipment, the need to store clean equipment, and the ability to restrict access to the area being investigated. Locate the decontamination area an adequate distance away and upwind from potential contaminant sources to avoid recontamination of clean equipment.

5.2 Types of Equipment

Drilling equipment that must be decontaminated includes drill bits, auger sections, drill-string tools, drill rods, split barrel samplers, tremie pipes, clamps, hand tools, and steel cable. Decontamination of monitoring well development and groundwater sampling equipment includes submersible pumps, bailers, interface probes, water level meters, bladder pumps, airlift pumps, peristaltic pumps, and lysimeters. Other sampling equipment that requires decontamination includes, but is not limited to, hand trowels, hand augers, slide hammer samplers, shovels, stainless-steel spoons and bowls, soil sample liners and caps, wipe sampling templates, composite liquid waste samplers, and dippers. Equipment with a porous surface, such as bailing twine, rope, cloth hoses, and wooden blocks cannot be thoroughly decontaminated and shall be properly disposed after one use.

5.3 Frequency of Equipment Decontamination

Decontaminate down-hole drilling equipment and equipment used in monitoring well development and purging prior to initial use and between each borehole or well. Down-hole drilling equipment, however, may require more frequent cleaning to prevent cross-contamination between vertical zones within a single borehole. When drilling through a shallow contaminated zone and installing a surface casing to seal off the contaminated zone, decontaminate the drilling tools prior to drilling deeper.

Initiate groundwater sampling from the monitoring well where the least contamination is suspected. Decontaminate groundwater, surface water, and soil sampling devices prior to initial use and between collection of each sample to prevent the possible introduction of contaminants into successive samples.

5.4 Cleaning Solutions and Techniques

Decontamination is accomplished using a variety of techniques and fluids. The preferred method of decontaminating major equipment, such as drill bits, augers, drill string, and pump drop-pipe, is steam cleaning. To steam clean, use a portable, high-pressure steam cleaner equipped with a pressure hose and fittings. For this method, thoroughly steam wash equipment, and rinse it with potable tap water to remove particulates and contaminants.

A rinse decontamination procedure is acceptable for small equipment such as bailers, water level meters, new and re-used soil sample liners, and hand tools. The decontamination procedure shall consist of the following:

1. Wash with a non-phosphate detergent (alconox, liquinox, or other suitable detergent) and potable water solution.

2. Rinse with potable water.

3. Spray with laboratory-grade isopropyl alcohol or other appropriate solvent (if used).

4. Rinse with deionized or distilled water.

5. Spray with deionized or distilled water. If possible, disassemble equipment prior to cleaning. Add a second wash at the beginning of the process if equipment is very soiled.

Isopropyl alcohol may contribute to acetone formation; therefore, its use in decontamination of equipment used for sampling volatile organic compounds should be considered. Solvents other than isopropyl alcohol may be used, depending upon the contaminants involved. For example, if polychlorinated biphenyls or chlorinated pesticides are contaminants of concern, hexane may be used as the decontamination solvent. However, if samples are also to be analyzed for volatile organics, hexane shall not be used. In addition, some decontamination solvents have health effects that must be considered. Decontamination water shall consist of distilled or deionized water. Steam-distilled water shall not be used in the decontamination process as this type of water usually contains elevated concentrations of metals. Decontamination solvents to be used during field activities will be specified in CTO work plan (WP) or site-specific SAP.

Decontaminating submersible pumps requires additional effort because internal surfaces become contaminated during usage. Decontaminate these pumps by washing and rinsing the outside surfaces using the procedure described for small equipment or by steam cleaning. Decontaminate the internal surfaces by recirculating fluids through the pump while it is operating. This recirculation may be done using a relatively long (typically 4-feet) large-diameter pipe (4-inch or greater) equipped with a bottom cap. Fill the pipe with the decontamination fluids, place the pump within the capped pipe, and operate the pump while recirculating the fluids back into the pipe. The decontamination sequence shall include:

1. Detergent and potable water,
2. Potable water rinse,
3. Potable water rinse, and
4. Deionized water rinse. Change the decontamination fluids after each decontamination cycle.

Rinse equipment used for measuring field parameters, such as pH (indicates the hydrogen ion concentration — acidity or basicity), temperature, specific conductivity, and turbidity with deionized or distilled water after each measurement. Also wash new, unused soil sample liners and caps with a fresh detergent solution and rinse them with potable water followed by distilled or deionized water to remove any dirt or cutting oils that might be on them prior to use.

5.5 Containment of Residual Contaminants and Cleaning Solutions

A decontamination program for equipment exposed to potentially hazardous materials requires a provision for catchment and disposal of the contaminated material, cleaning solution, and wash water.

When contaminated material and cleaning fluids must be contained from heavy equipment, such as drill rigs and support vehicles, the area must be properly floored, preferably with a concrete pad that slopes toward a sump pit. If a concrete pad is impractical, planking can be used to construct solid flooring that is then covered by a nonporous surface and sloped toward a collection sump. If the decontamination area lacks a collection sump, use plastic sheeting and blocks or other objects to create a bermed area for collection of equipment decontamination water. Situate smaller items such as auger flights on metal stands or other similar equipment during decontamination to prevent contact with fluids generated by previous equipment decontamination. Collect decontamination fluids contained within the bermed area and store them in secured containers such as Department of Transportation (DOT)-approved drums, until their disposition is determined by laboratory analytical results.

Store clean equipment in a separate location to prevent recontamination.

Use wash buckets or tubs to catch fluids from the decontamination of lighter-weight drilling equipment and hand-held sampling devices. Collect the decontamination fluids and store them onsite in secured containers, such as DOT-approved drums, until their disposition is determined by laboratory analytical results.

5.6 Effectiveness of Decontamination Procedures

A decontamination program must incorporate quality control measures to determine the effectiveness of cleaning methods. Quality control measures typically include collection of equipment blank samples or wipe testing. Equipment blanks consist of analyte-free water that has been poured over or through the sample collection equipment after its final decontamination rinse. Wipe testing is performed by wiping a cloth over the surface of the equipment after cleaning. These quality control measures provide "after-the fact" information that may be useful in determining whether or not cleaning methods were effective in removing the contaminants of concern.

6.0 RECORDS

Describe the decontamination process in the field logbook.

7.0 HEALTH AND SAFETY

It is the responsibility of the Site Safety Office (SSO) to set up the site zones (i.e., exclusion, transition, and clean) and decontamination areas. Generally, the decontamination area is located within the transition zone, upwind of intrusive activities, and serves as the washing area for both personnel and equipment to minimize the spread of contamination into the clean zone. For equipment, a series of buckets are set up on a visqueen-lined bermed area. Separate spray bottles containing solvents (if required) and distilled water are used for final rinsing of equipment. Depending on the nature of the hazards and the site location, decontamination of heavy equipment, such as augers, pump drop pipe, and vehicles, may be accomplished using a variety of techniques.

Personnel responsible for equipment decontamination must adhere to the site-specific health and safety plan (HASP) and must wear the personal protective equipment (PPE) specified in the site-specific HASP. Generally this includes, at a minimum, Tyvek coveralls, steel-toed boots with boot covers or steel-toed rubber boots, safety glasses, American National Standards Institute-standard hard hats, and hearing protection (if heavy equipment is in operation). Air monitoring by the SSO may result in an upgrade to the use of respirators and cartridges in the decontamination area; therefore, this equipment must be available onsite. If safe alternatives are not achievable, discontinue site activities immediately.

In addition to the aforementioned precautions, employ the following safe work practices:

Chemical Hazards Associated With Equipment Decontamination

- Avoid skin contact with and/or incidental ingestion of decontamination solutions and water.
- Utilize PPE as specified in the site-specific HASP to maximize splash protection.
- Refer to material safety data sheets, safety personnel, and/or consult sampling personnel regarding appropriate safety measures (i.e., handling, PPE including skin and respiratory).
- Take the necessary precautions when handling detergents and reagents.

Physical Hazards Associated With Equipment Decontamination

- To avoid possible back strain, it is recommended to raise the decontamination area 1 to 2 feet above ground level.

- To avoid heat stress, over exertion, and exhaustion, it is recommended to rotate equipment decontamination among all site personnel.

- Take necessary precautions when handling field sampling equipment.

8.0 REFERENCES

Department of Defense, United States (DoD). 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U.S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at:http://www.epa.gov/fedfac/pdf/-ufp_qapp_v1_0305.pdf.

9.0 ATTACHMENTS

None.

Standard Operating Procedure SOP-3-07
Land Surveying

Land Surveying

Procedure 3-07

1.0 Purpose and Scope

1.1 The purpose of this document is to define the standard operating procedure (SOP) for acquiring land surveying data to facilitate the location and mapping of geologic, hydrologic, geotechnical data, and analytical sampling points and to establish topographic control over project sites.

1.2 This procedure is the Program-approved professional guidance for work performed by Resolution Consultants under the Comprehensive Long-Term Environmental Action Navy (CLEAN) contract (Contract Number N62470-11-D-8013).

1.3 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review. If there are procedures whether it be from Resolution Consultants, state and/or federal that are not addressed in this SOP and are applicable to surface water sampling then those procedures may be added as an appendix to the project specific SAP.

1.4 It is fully expected that the procedures outlined in this SOP will be followed. Procedural modifications may be warranted depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP will be approved in advance by the Program Quality Manager. Deviations to this SOP will be documented in the field records.

1.5 If there are procedures, whether it be from Resolution Consultants, state and/or federal, that are not addressed in this SOP and are applicable to land surveying then those procedures may be added as an appendix to the project specific Sampling and Analysis Plan (SAP).

2.0 Safety

2.1 Depending upon the site-specific contaminants, various protective programs must be implemented prior to conducting fieldwork. All **field sampling personnel** must review the project-specific health and safety plan (HASP) paying particular attention to the control measures planned for the specific field tasks. Conduct preliminary area monitoring to determine the potential hazard to field sampling personnel. If significant contamination is observed, minimize contact with potential contaminants in both the vapor and liquid phase through the use of respirators and disposable clothing.

2.2 In addition, observe standard health and safety practices according to the project-specific HASP. Suggested minimum protection includes inner disposable vinyl gloves, outer chemical-protective nitrile gloves, rubberized steel-toed boots, and an American National Standards Institute-standard hard hat. Half-face respirators and cartridges and Tyvek® suits may be necessary depending on the contaminant concentrations, and shall always be available on site.

2.3 Daily safety briefs will be conducted at the start of each working day before any work commences. These daily briefs will be facilitated by the **Site Safety Officer (SSO)** or designee to discuss the day's events and any potential health risk areas covering every aspect of the work to be completed. Weather conditions are often part of these discussions. As detailed in the HASP, everyone on the field team has the authority to stop work if an unsafe condition is perceived until the conditions are fully remedied to the satisfaction of the SSO.

2.4 The health and safety considerations for the work associated with land surveying include:

- Slip, trips and falls associated with work in the field;

- Biological hazards associated with work in the field; and,
- Potential hazards associated with contaminants of concern (COC) that may be located in the survey area,

3.0 Terms and Definitions

3.1 Boundary Survey

Boundary surveys are conducted by Certified Land Surveyors in order to delineate a legal property line for a site or section of a site.

3.2 Global Positioning System (GPS)

A system of satellites, computers, and receivers that is able to determine the latitude and longitude of a receiver on Earth by calculating the time difference for signals from different satellites to reach the receiver.

4.0 Interferences

4.1 Commercially available GPS units typically have a level of precision of (±) 3 to 5 meters. Field corrections can be made as described in Section 8.3 below.

5.0 Training and Qualifications

5.1 Qualifications and Training

5.1.1 The individual executing these procedures must have read, and be familiar with, the requirements of this SOP.

5.2 Responsibilities

5.2.1 The **Contract Task Order (CTO) Manager** is responsible for ensuring that land surveying activities comply with this procedure. The CTO Manager is responsible for ensuring that all field sampling personnel involved in land surveying shall have the appropriate education, experience, and training to perform their assigned tasks.

5.2.2 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.

5.2.3 The **Field Manager (FM)** is responsible for ensuring that all field personnel follow these procedures. In virtually all cases, subcontractors will conduct these procedures. The FM or designee is responsible for overseeing the activities of the subcontractor and ensuring that sampling points and topographic features are properly surveyed.

6.0 Equipment and Supplies

6.1 The following equipment list contains materials that may be needed in carrying out the procedures outlined in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- Personal protective equipment (PPE) and other safety equipment, as required by the HASP;
- Commercially available GPS unit; and,
- Field Logbook.

7.0 Calibration or Standardization

7.1 An authorized manufacturer's representative shall inspect and calibrate survey instruments in accordance with the manufacturer's specifications regarding procedures and frequencies. At a minimum, instruments shall be calibrated no more than six months prior to the start of the survey work.

7.2 Standards for all survey work shall be in accordance with National Oceanic and Atmospheric Administration standards and, at a minimum, with accuracy standards set forth below. The horizontal accuracy for the location of all grid intersection and planimetric features shall be (±) 0.1 feet. The horizontal accuracy for boundary surveys shall be 1 in 10,000 feet (1:10,000). The vertical accuracy for ground surface elevations shall be (±) 0.1 feet. Benchmark elevation accuracy and elevation of other permanent features, including monitoring wellheads, shall be (±) 0.01 feet.

8.0 Procedure

8.1 Theodolite/Electronic Distance Measurement (EDM)

Follow the procedures listed below during theodolite/EDM land surveying conducted under the NAVFAC CLEAN Program:

- A land surveyor registered in the state or territory in which the work is being performed shall directly supervise all surveying work.
- Reference surveys to the local established coordinate systems and base all elevations and benchmarks established on U.S. Geological Survey datum, 1929 general adjustment.
- Reference surveyed points to Mean Sea Level (Lower Low Water Level).
- Jointly determine appropriate horizontal and vertical control points prior to the start of survey activities. If discrepancies in the survey (e.g., anomalous water level elevations) are observed, the surveyor may be required to verify the survey by comparison to a known survey mark. If necessary, a verification survey may be conducted by a qualified third party.
- All field notes, sketches, and drawings shall clearly identify the horizontal and vertical control points by number designation, description, coordinates, and elevations. Map all surveyed locations using a base map or other site mapping, as specified by the project Work Plan or SAP.
- Begin and end all surveys at the designated horizontal and vertical control points to determine the degree of accuracy of the surveys.
- Iron pins used to mark control points shall be made of reinforcement steel or an equivalent material and shall be 18 inches long with a minimum diameter of 5/8 inch. Drive pins to a depth of 18 inches into the soil.
- Stakes used to mark survey lines and points shall be made from 3-foot lengths of 2-inch by 2-inch lumber and pointed at one end. Clearly mark them with brightly colored weatherproof flagging and paint.
- Clearly mark the point on a monitoring well casing or well riser that is surveyed by filing grooves into the casing/riser on either side of the surveyed point, or by marking the riser with a permanent ink marker.

8.2 Global Positioning System (GPS) to Conduct Land Survey

Follow the procedures listed below during land surveying using GPS:

- A land surveyor registered in the state or territory in which the work is being performed shall directly supervise all surveying work.
- Reference surveys to the local established coordinate systems and base all elevations and benchmarks established on U.S. Geological Survey datum, 1929 general adjustment.

- All field notes, sketches, and drawings shall clearly identify the horizontal and vertical control points by number designation, description, coordinates, and elevations. Map all surveyed locations using a base map or other site mapping, as specified in the project Work Plan or SAP.
- Begin and end all surveys at the designated horizontal and vertical control points (as applicable) to determine the degree of accuracy of the surveys.
- Iron pins used to mark control points shall be made of reinforcement steel or an equivalent material and shall be 18 inches long with a minimum diameter of 5/8 inch. Drive pins to a depth of 18 inches into the soil.
- Stakes used to mark survey lines and points shall be made from 3-foot lengths of 2-inch by 2-inch lumber and pointed at one end. Clearly mark them with brightly colored weatherproof flagging and paint.
- Clearly mark the point on a monitoring well casing that is surveyed by filing grooves into the casing on either side of the surveyed point.

8.3 Global Positioning System (GPS) to Position Sample Locations or Locate Site Features

Experienced field personnel may use a GPS system unit to position sample locations (e.g. grid positioned samples, soil boring locations) at a site. The decision to use field personnel or a licensed land surveyor will depend on the objectives of the survey (e.g. vertical elevation is not required) and the levels of precision required. Typically when a level of precision greater than (±) 3 to 5 meters is required, a licensed surveyor will be required. When a level of precision of (±) 3 to 5 meters is sufficient to meet project requirements (i.e. when laying sampling grids, identifying significant site features, or locating features identified in GIS figures) experienced field personnel may use commercially available, consumer-grade GPS units. Follow the procedures listed below to locate samples or site features using GPS:

- A commercially available GPS unit with Wide Angle Averaging System (WAAS), topographic map display, and waypoint storage capabilities should be used.
- If waypoints are to be imported into a GIS database, the same grid projection system should be used.
- If a permanent reference point near the site is available, it is recommended that a waypoint at this location be taken every day waypoints are stored.
- When laying out a sampling grid from a GIS map, upload the coordinates from GIS to the GPS unit, including coordinates for an easily identified, permanent, nearby feature (i.e. building corner, roadway intersection, or USGS benchmark).
- If during the initial site walk, the permanent feature identified does not overlay within (±) 5 meters as identified in the GPS unit, field corrections of the waypoints should be made.
- Field corrections can be made by adding/subtracting the difference in x,y coordinates between the field measurement of the permanent site feature and the anticipated x,y coordinates. This correction should then be applied to the x,y coordinates for each sampling location to be marked. Corrected x,y coordinates can then be uploaded into the GPS unit.
- Sampling points and site features can then be located in the field using the GPS units "Go To" function. When the distance to the sampling point or feature remains close to zero, the location can be marked.
- If no field corrections to the sampling location need to be made, or if sampling locations are to be surveyed by a licensed surveyor at a later date, no additional waypoints need to be taken. If significant changes to the sampling location are made, GPS coordinates at the corrected location shall be stored and labeled.

- It is recommended that GPS coordinates be uploaded to a storage device such as PC at the end of each day.
- Field logs shall indicate manufacturer and model number for GPS unit used, map datum and projection used, and any field corrections made. If the GPS unit cannot lock onto a WAAS system at the site, this should also be noted.

9.0 Quality Control and Assurance

None.

10.0 Data and Records Management

The surveyor shall record field notes daily using generally accepted practices. The data shall be neat, legible, in indelible ink, and easily reproducible. Copies of the surveyor's field notes and calculation forms generated during the work shall be obtained and placed in the project files.

Surveyor's field notes shall, at a minimum, clearly indicate:

- The date of the survey;
- General weather conditions;
- The name of the surveying firm;
- The names and job titles of personnel performing the survey work;
- Equipment used, including serial numbers; and,
- Field book designations, including page numbers.

A land surveyor registered in the state or territory in which the work was done shall sign, seal, and certify the drawings and calculations submitted by the surveyor.

Dated records of land surveying equipment calibration shall be provided by the surveyor and placed in the project files. Equipment serial numbers shall be provided in the calibration records.

11.0 Attachments or References

Department of Defense, United States (DoD). 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

Author	*Reviewer*	*Revisions (Technical or Editorial)*
Robert Shoemaker Senior Scientist	Naomi Ouellette, Project Manager	Rev 0 – Initial Issue

Standard Operating Procedure SOP-3-08 (MS)
Soil Classification

1.0 PURPOSE

This section sets forth standard operating procedures for soil classification. If there are procedures from Resolution Consultants, state and/or federal that are not addressed in this Standard Operating Procedure (SOP) and are applicable to soil and rock classification then those procedures may be added as an appendix to the project specific Sampling and Analysis Plan (SAP).

2.0 SCOPE

This procedure shall serve as management-approved professional guidance and is consistent with protocol in the Uniform Federal Policy-Quality Assurance Project Plan (DoD 2005). As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment during unforeseen circumstances. Deviations from this procedure while planning or executing planned activities must be approved by either the Contract Task Order (CTO) Manager or the Quality Assurance (QA) Manager, and documented.

3.0 DEFINITIONS

None.

4.0 RESPONSIBILITIES

The CTO Manager, or designee, is responsible for ensuring that these standard soil and rock classification procedures are followed and that a qualified individual conducts or supervises the projects. A qualified individual is defined as a person with a degree in geology, hydrogeology, soil science, or geotechnical/civil engineering with at least 1 year of experience classifying soil. Supervision is defined as onsite and continuous monitoring of the individual conducting soil classification. The CTO Manager is responsible for ensuring that all personnel involved in soil and rock classification shall have the appropriate education, experience, and training to perform their assigned tasks. The CTO Manager is responsible for reviewing copies of the field boring log forms on a monthly basis at a minimum.

QA Manager or Technical Director is responsible for ensuring overall compliance with this procedure.

The Field Manager is responsible for ensuring that all project field staff follow these procedures.

Field personnel are responsible for the implementation of this procedure.

5.0 SOIL CLASSIFICATION

The basic purpose of the classification of soil is to thoroughly describe the physical characteristics of the sample and to classify it according to an appropriate soil classification system. The Unified Soil Classification System (USCS) was developed so that soils could be described on a common basis by different investigators and serve as a "shorthand" description of soil. A classification of a soil in accordance with the USCS includes not only a group symbol and name, but also a complete word description.

Describing soil on a common basis is essential so that soil described by different site qualified personnel is comparable. Site individuals describing soil as part of site activities *must* use the classification system described herein to provide the most useful geologic database for all present and future subsurface investigations and remedial activities.

The site geologist or other qualified individual shall describe the soil and record the description in a boring log or logbook. The essential items in any written soil description are as follows:

- Classification group name (e.g., silty sand)
- Color, moisture, and odor
- Range of particle sizes and maximum particle size
- Approximate percentage of boulders, cobbles, gravel, sand, and fines
- Plasticity characteristics of the fines
- In-place conditions, such as consistency, density, and structure
- USCS classification symbol

The USCS serves as "shorthand" for classifying soil into 15 basic groups:

- GW[1] Well graded (poorly sorted) gravel (>50 percent gravel, <5percent fines)
- GP[1] Poorly graded (well sorted) gravel (>50percent gravel, <5percent fines)
- GM[1] Silty gravel (>50 percent gravel, >15 percent silt)
- GC[1] Clayey gravel (>50 percent gravel, >15 percent clay)
- SW[1] Well graded (poorly sorted) sand (>50 percent sand, <5 percent fines)
- SP[1] Poorly graded (well sorted) sand (>50 percent sand, <5 percent fines)

[1] If percentage of fine is 5 percent to 15 percent, a dual identification shall be given (e.g., a soil with more than 50 percent poorly sorted gravel and 10 percent clay is designated GW-GC.

- SM[1] Silty sand (>50 percent sand, >15 percent silt)
- SC[1] Clayey sand (>50 percent sand, >15 percent clay)
- ML[2] Inorganic, low plasticity silt (slow to rapid dilatancy, low toughness, and plasticity)
- CL[2] Inorganic, low plasticity (lean) clay (no or slow dilatancy, medium toughness and plasticity)
- MH[2] Inorganic elastic silt (no to slow dilatancy, low to medium toughness and plasticity)
- CH[2] Inorganic, high plasticity (fat) clay (no dilatancy, high toughness, and plasticity)
- OL Organic low plasticity silt or organic silty clay
- OH Organic high plasticity clay or silt
- PT Peat and other highly organic soil

Figure 1 defines the terminology of the USCS. Flow charts presented in Figure 2 and Figure 3 indicate the process for describing soil. The particle size distribution and the plasticity of the fines are the two properties of soil used for classification. In some cases, it may be appropriate to use a borderline classification (e.g., SC/CL) if the soil has been identified as having properties that do not distinctly place the soil into one group.

5.1 Estimation of Particle Size Distribution

One of the most important factors in classifying a soil is the estimated percentage of soil constituents in each particle size range. Being proficient in estimating this factor requires extensive practice and frequent checking. The steps involved in determining particle size distribution are listed below:

1. Select a representative sample (approximately 1/2 of a 6-inch long by 2.5-inch diameter sample liner).

2. Remove all particles larger than 3 inches from the sample. Estimate and record the percent by volume of these particles. Only the fraction of the sample smaller than 3 inches is classified.

[2] If the soil is estimated to have 15 percent to 25 percent sand or gravel, or both, the words "with sand" or "with gravel" (whichever predominates) shall be added to the group name (e.g., clay with sand, CL; or silt with gravel, ML). If the soil is estimated to have 30 percent or more sand or gravel, or both, the words "sandy" or "gravely" (whichever predominates) shall be added to the group name (e.g., sandy clay, CL). If the percentage of sand is equal to the percent gravel, use "sandy."

DEFINITION OF TERMS

MAJOR DIVISIONS			SYMBOLS	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS More Than Half of Material is Larger Than No. 200 Sieve Size	GRAVELS More Than Half of Coarse Fraction is Smaller Than No. 4 Sieve	CLEAN GRAVELS (Less than 6% Fines)	GW	Well graded gravels, gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines
		GRAVELS With Fines	GM	Silty gravels, gravel-sand-silt mixtures, non-plastic fines
			GC	Clayey gravels, gravel-sand-clay mixtures, plastic fines
	SANDS More Than Half of Coarse Fraction is Smaller Than No. 4 Sieve	CLEAN SANDS (Less than 6% Fines)	SW	Well graded sands, gravelly sands, little or no fines
			SP	Poorly graded sands, gravelly sands, little or no fines
		SANDS With Fines	SM	Silty sands, sand-silt mixtures, non-plastic fines
			SC	Clayey sands, sand-clay mixtures, plastic fines
FINE GRAINED SOILS More Than Half of Material is Smaller Than No. 200 Sieve Size	SILTS AND CLAYS Liquid Limit is Less Than 50%		ML	Inorganic silts, rock flour, fine sandy silts or clays, and clayey silts with non- or slightly-plastic fines
			CL	Inorganic clays of low to medium plasticity, gravelly clays, silty clays, sandy clays, lean clays
			OL	Organic silts and organic silty clays of low plasticity
	SILTS AND CLAYS Liquid Limit is Greater Than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts, clayey silt
			CH	inorganic clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS			PT	Peat and other highly organic soils

GRAIN SIZES

SILTS AND CLAYS	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		
200	40	10	4	3/4"	3"	12"	

U.S. STANDARD SERIES SIEVE — CLEAR SQUARE SIEVE OPENINGS

Figure 1: Unclassified Soil Classification System (USCS)

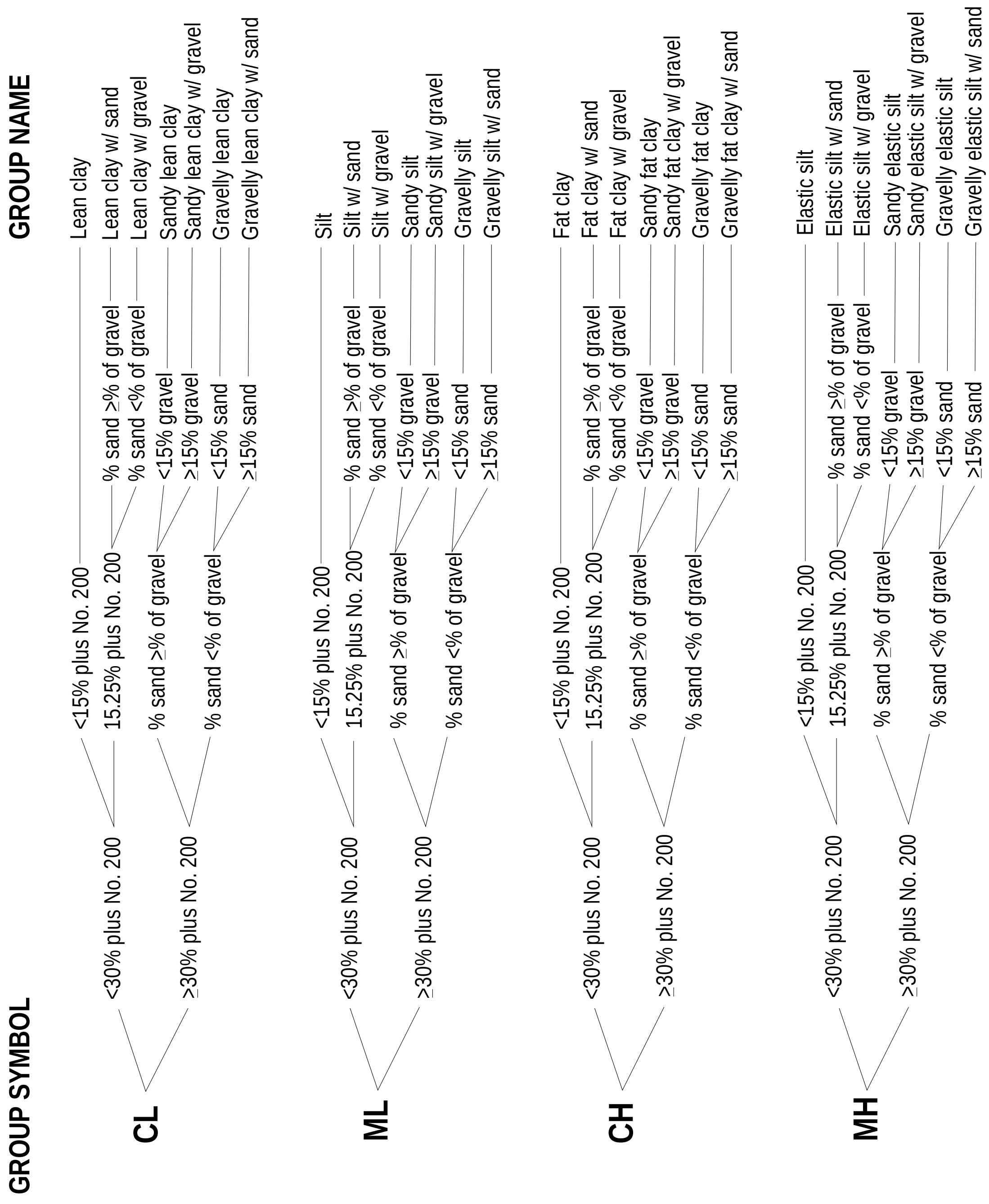


Figure 2: Flow Chart for Fine Grain Soil Classification

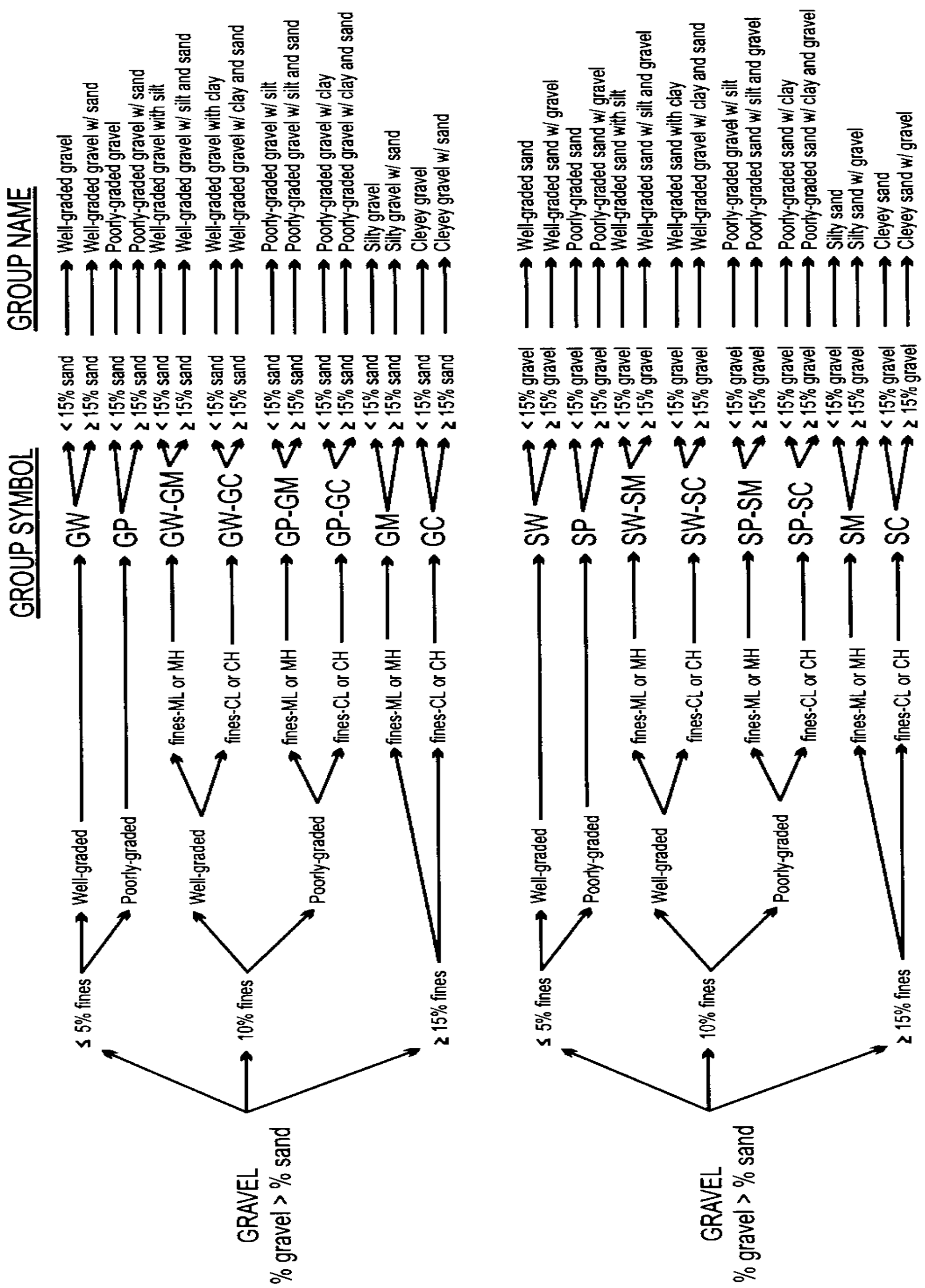


Figure 3: Flow Chart for Soil with Gravel

3. Estimate and record the percentage of dry mass of gravel (less than 3 inches and greater than 1/4 inch).

4. Considering the rest of the sample, estimate, and record the percentage of dry mass of sand particles (about the smallest particle visible to the unaided eye).

5. Estimate and record the percentage of dry mass of fines in the sample (do not attempt to separate silts from clays).

6. Estimate percentages to the nearest 5 percent. If one of the components is present in a quantity considered less than 5 percent, indicate its presence by the term "trace".

7. The percentages of gravel, sand, and fines must add up to 100 percent. "Trace" is not included in the 100 percent total.

5.2 Soil Dilatancy, Toughness, and Plasticity

5.2.1 Dilatancy

To evaluate dilatancy, follow these procedures:

1. From the specimen, select enough material to mold into a ball about 1/2 inch (12 millimeters [mm]) in diameter. Mold the material, adding water if necessary, until it has a soft, but not sticky, consistency.

2. Smooth the soil ball in the palm of one hand with the blade of a knife or small spatula. Shake horizontally, striking the side of the hand vigorously against the other hand several times. Note the reaction of water appearing on the surface of the soil. Squeeze the sample by closing the hand or pinching the soil between the fingers, and note the reaction as none, slow, or rapid in accordance with the criteria in Table 1. The reaction is the speed with which water appears while shaking, and disappears while squeezing.

Table 1
Criteria for Describing Dilatancy

Description	Criteria
None	No visible change in specimen.
Slow	Water appears slowly on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing.
Rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing.

5.2.2 Toughness

Following the completion of the dilatancy test, shape the test specimen into an elongated pat and roll it by hand on a smooth surface or between the palms into a thread about 1/8 inch (3 mm) in diameter. (If the sample is too wet to roll easily, spread it into a thin layer and allow it to lose some water by evaporation.) Fold the sample threads and re-roll repeatedly until the thread crumbles at a diameter of about 1/8 inch. The thread will crumble at a diameter of 1/8 inch when the soil is near the plastic limit. Note the pressure required to roll the thread near the plastic limit. Also, note the strength of the thread. After the thread crumbles, lump the pieces together and knead it until the lump crumbles. Note the toughness of the material during kneading. Describe the toughness of the thread and lump as low, medium, or high in accordance with the criteria in Table 2.

Table 2
Criteria for Describing Toughness

Description	Criteria
Low	Only slight pressure is required to roll the thread near the plastic limit. The thread and the lump are weak and soft.
Medium	Medium pressure is required to roll the thread near the plastic limit. The thread and the lump have medium stiffness.
High	Considerable pressure is required to roll the thread near the plastic limit. The thread and the lump have very high stiffness.

5.2.3 Plasticity

The plasticity of a soil is defined by the ability of the soil to deform without cracking, the range of moisture content over which the soil remains in a plastic state, and the degree of cohesiveness at the plastic limit. The plasticity characteristic of clays and other cohesive materials is defined by the liquid limit and plastic limit. The liquid limit is defined as the soil moisture content at which soil passes from the liquid to the plastic state as moisture is removed. The test for the liquid limit is a laboratory, not a field, analysis.

The plastic limit is the soil moisture content at which a soil passes from the plastic to the semi-solid state as moisture is removed. The plastic limit test can be performed in the field and is indicated by the ability to roll a 1/8-inch (0.125-inch) diameter thread of fines, the time required to roll the thread, and the number of times the thread can be re-rolled when approaching the plastic limit.

The plasticity tests are not based on natural soil moisture content, but on soil that has been thoroughly mixed with water. If a soil sample is too dry in the field, add water prior to performing classification. If a soil sample is too sticky, spread the sample thin and allow it to lose some soil moisture.

Table 3 presents the criteria for describing plasticity in the field using the rolled thread method.

Table 3
Criteria for Describing Plasticity

Description	Criteria
Non-Plastic	A 1/8-inch thread cannot be rolled.
Low Plasticity	The thread can barely be rolled.
Medium Plasticity	The thread is easy to roll and not much time is required to reach the plastic limit.
High Plasticity	It takes considerable time rolling the thread to reach the plastic limit.

5.2.4 Angularity

The following criteria describe the angularity of the coarse sand and gravel particles:

- **Rounded** particles have smoothly-curved sides and no edges.
- **Subrounded** particles have nearly plane sides, but have well-rounded corners and edges.
- **Subangular** particles are similar to angular, but have somewhat rounded or smooth edgesand.
- **Angular** particles have sharp edges and relatively plane sides with unpolished surfaces. Freshly broken or crushed rock would be described as angular.

5.2.5 Color, Moisture, and Odor

The natural moisture content of soil is very important. Table 4 shows the terms for describing the moisture condition and the criteria for each.

Table 4
Soil Moisture Content Qualifiers

Qualifier	Criteria
Dry	Absence of moisture, dry to the touch
Moist	Damp but no visible water
Wet	Visible water, usually soil is below water table

Color is described by hue and chroma using the Munsell Soil Color Chart (Munsell 2000). For uniformity, all site geologists shall utilize this chart for soil classification. Doing so will facilitate correlation of geologic units between boreholes logged by different geologists The Munsell Color Chart is a small booklet of numbered color chips with names like "5YR 5/6, yellowish-red." Note mottling or banding of colors. It is particularly important to note and describe staining because it may indicate contamination.

In general, wear a respirator if strong organic odors are present. If odors are noted, describe them if they are unusual or suspected to result from contamination. An organic odor may have the distinctive smell of decaying vegetation. Unusual odors may be related to hydrocarbons, solvents, or other chemicals in the subsurface. An organic vapor analyzer may be used to detect the presence of volatile organic contaminants.

5.2.6 In-Place Conditions

Describe the conditions of undisturbed soil samples in terms of their density/consistency (i.e., compactness), cementation, and structure utilizing the following guidelines:

5.2.6.1 Density/Consistency

Density and consistency describe a physical property that reflects the relative resistance of a soil to penetration. The term "density" is commonly applied to coarse to medium-grained sediments (i.e., gravels, sands), whereas the term "consistency" is normally applied to fine-grained sediments (i.e., silts, clays). There are separate standards of measure for both density and consistency that are used to describe the properties of a soil.

The density or consistency of a soil is determined by observing the number of blows required to drive a 1 3/8-inch (35 mm) diameter split barrel sampler 18 inches using a drive hammer weighing 140 lbs (63.5 kilograms [kg]) dropped over a distance of 30 inches (0.76 meters). Record the number of blows required to penetrate each 6 inches of soil in the field boring log during sampling. The first 6 inches of penetration is considered to be a seating drive; therefore, the blow count associated with this seating drive is recorded, but not used in determining the soil density/consistency. The sum of the number of blows required for the second and third 6 inches of penetration is termed the "standard penetration resistance," or the "N-value." The observed number of blow counts must be corrected by an appropriate factor if a different type of sampling device (e.g., Modified California Sampler with liners) is used. For a 2 3/8-inch inner diameter (I.D.) Modified California Sampler equipped with brass or stainless steel liners and penetrating a cohesionless soil (sand/gravel), the N-value from the Modified California Sampler must be divided by 1.43 to provide data that can be compared to the 1 3/8-inch diameter sampler data.

For a cohesive soil (silt/clay), the N-value for the Modified California Sampler should be divided by a factor of 1.13 for comparison with 1 3/8-inch diameter sampler data.

Drive the sampler and record blow counts for each 6-inch increment of penetration until one of the following occurs:

- A total of 50 blows have been applied during any one of the three 6-inch increments; a 50-blow count occurrence shall be termed "refusal" and noted as such on the boring log.
- A total of 150 blows have been applied.
- The sampler is advanced the complete 18 inches without the limiting blow counts occurring, as described above.

If the sampler is driven less than 18 inches, record the number of blows per partial increment on the boring log. If refusal occurs during the first 6 inches of penetration, the number of blows will represent the N-value for this sampling interval. Table 5 and Table 6 present representative descriptions of soil density/consistency vs. N-values.

Table 5
Measuring Soil Density with a California Sample — Relative Density (Sands, Gravels)

	Field Criteria (N-Value)	
Description	**1 3/8 in. ID Sampler**	**2 in. ID Sampler using 1.43 factor**
Very Loose	0–4	0–6
Loose	4–10	6–14
Medium Dense	10–30	14–43
Dense	30–50	43–71
Very Dense	> 50	> 71

Table 6
Measuring Soil Density with a California Sampler — Fine Grained Cohesive Soil

Description	Field Criteria (N-Value) 1 3/8 in. ID Sampler	Field Criteria (N-Value) 2 in. ID Sampler using 1.13 factor
Very Soft	0–2	0–2
Soft	2–4	2–4
Medium Stiff	4–8	4–9
Stiff	8–16	9–18
Very Stiff	16–32	18–36
Hard	> 32	> 36

For undisturbed fine-grained soil samples, it is also possible to measure consistency with a hand-held penetrometer. The measurement is made by placing the tip of the penetrometer against the surface of the soil contained within the sampling liner or shelby tube, pushing the penetrometer into the soil a distance specified by the penetrometer manufacturer, and recording the pressure resistance reading in pounds per square foot (psf). The values are as follows (Table 7):

Table 7
Measuring Soil Consistency with a Hand-Held Penetrometer

Description	Pocket Penetrometer Reading (psf)
Very Soft	0–250
Soft	250–500
Medium Stiff	500–1000
Stiff	1000–2000
Very Stiff	2000–4000
Hard	>4000

Consistency can also be estimated using thumb pressure using Table 8.

Table 8
Measuring Soil Consistency Using Thumb Pressure

Description	Criteria
Very Soft	Thumb will penetrate soil more than 1 inch (25 mm)
Soft	Thumb will penetrate soil about 1 inch (25 mm)
Firm	Thumb will penetrate soil about 1/4 inch (6 mm)
Hard	Thumb will not indent soil but readily indented with thumbnail
Very Hard	Thumbnail will not indent soil

5.2.6.2 Cementation

Cementation is used to describe the friability of a soil. Cements are chemical precipitates that provide important information as to conditions that prevailed at the time of deposition, or conversely, diagenetic effects that occurred following deposition. Seven types of chemical cements are recognized by Folk (1980). They are as follows:

1. Quartz — siliceous

2. Chert — chert-cemented or chalcedonic

3. Opal — opaline

4. Carbonate — calcitic, dolomitic, sideritic (if in doubt, calcareous should be used)

5. Iron oxides — hematitic, limonitic (if in doubt, ferruginous should be used)

6. Clay minerals — if the clay minerals are detrital or have formed by recrystallization of a previous clay matrix, they are not considered to be a cement. Only if they are chemical precipitates, filling previous pore space (usually in the form of accordion-like stacks or fringing radial crusts) should they be included as "kaolin-cemented," "chlorite-cemented," etc.

7. Miscellaneous minerals — pyritic, collophane-cemented, glauconite-cemented, gypsiferous, anhydrite-cemented, baritic, feldspar-cemented, etc.

The degree of cementation of a soil is determined qualitatively by utilizing finger pressure on the soil in one of the sample liners to disrupt the gross soil fabric. The three cementation descriptors are as follows:

1. Weak — friable; crumbles or breaks with handling or slight finger pressure
2. Moderate — friable; crumbles or breaks with considerable finger pressure
3. Strong — not friable; will not crumble or break with finger pressure

5.2.6.3 Structure

This variable is used to qualitatively describe physical characteristics of soil that are important to incorporate into hydrogeological and/or geotechnical descriptions of soil at a site. Appropriate soil structure descriptors are as follows:

- Granular — spherically shaped aggregates with faces that do not accommodate adjoining faces

- Stratified — alternating layers of varying material or color with layers at least 6 mm (1/4 inch) thick; note thickness

- Laminated — alternating layers of varying material or color with layers less than 6 mm (1/4 inch) thick; note thickness

- Blocky — cohesive soil that can be broken down into small angular or subangular lumps that resist further breakdown

- Lensed — inclusion of a small pocket of different soil, such as small lenses of sand, should be described as homogeneous if it is not stratified, laminated, fissured, or blocky. If lenses of different soil are present, the soil being described can be termed homogeneous if the description of the lenses is included

- Prismatic or Columnar — particles arranged about a vertical line, ped is bounded by planar, vertical faces that accommodate adjoining faces; prismatic has a flat top; columnar has a rounded top

- Platy — particles are arranged about a horizontal plane

5.2.6.4 Other Features

- Mottled — soil that appears to consist of material of two or more colors in blotchy distribution

- Fissured — breaks along definite planes of fracture with little resistance to fracturing (determined by applying moderate pressure to sample using thumb and index finger)

- Slickensided — fracture planes appear polished or glossy, sometimes striated (parallel grooves or scratches)

5.2.7 Development of Soil Description

Develop standard soil descriptions according to the following examples. There are three principal categories under which all soil can be classified. They are described below.

5.2.7.1 Coarse-grained Soil

Coarse-grained soil is divided into sands and gravels. A soil is classified as a sand if over 50 percent of the coarse fraction is "sand-sized." It is classified as a gravel if over 50 percent of the coarse fraction is composed of "gravel-sized" particles.

The written description of a coarse-grained soil shall contain, in order of appearance: Typical name including the second highest percentage constituent as an adjective, if applicable (underlined); grain size of coarse fraction; Munsell color and color number; moisture content; relative density; sorting; angularity; other features, such as stratification (sedimentary structures) and cementation, possible formational name, primary USCS classification, secondary USCS classification (when necessary), and approximate percentages of minor constituents (i.e., sand, gravel, shell fragments, rip-up clasts) in parentheses.

Example: <u>POORLY-SORTED SAND WITH SILT</u>, medium- to coarse-grained, light olive gray, 5Y 6/2, saturated, loose, poorly sorted, subrounded clasts, SW/SM (minor silt with approximately 20 percent coarse-grained sand-sized shell fragments, and 80 percent medium-grained quartz sand, and 5 percent to 15 percent ML).

5.2.7.2 Fine-grained Soil

Fine-grained soil is further subdivided into clays and silts according to its plasticity. Clays are rather plastic, while silts have little or no plasticity.

The written description of a fine-grained soil should contain, in order of appearance: Typical name including the second highest percentage constituent as an adjective, if applicable (underlined); Munsell color; moisture content; consistency; plasticity; other features, such as stratification, possible formation name, primary USCS classification, secondary USCS classification (when necessary), and the percentage of minor constituents in parentheses.

Example: SANDY LEAN CLAY, dusky red, 2.5 YR 3/2, moist, firm, moderately plastic, thinly laminated, CL (70 percent fines, 30 percent sand, with minor amounts of disarticulated bivalves [about 5 percent]).

5.2.7.3 Organic Soil

For highly organic soil, describe the types of organic materials present as well as the type of soil constituents present using the methods described above. Identify the soil as an organic soil, OL/OH, if the soil contains enough organic particles to influence the soil properties. Organic soil usually has a dark brown to black color and may have an organic odor. Often, organic soils will change color, (e.g., from black to brown) when exposed to air. Some organic soils will lighten in color significantly when air-dried. Organic soils normally will not have a high toughness or plasticity. The thread for the toughness test will be spongy.

Example: ORGANIC CLAY, black, 2.5Y, 2.5/1, wet, soft, low plasticity, organic odor, OL (100 percent fines), weak reaction to HCl.

6.0 RECORDS

Document soil classification information collected during soil sampling onto the field boring logs, field trench logs, and into the field notebook. Copies of this information shall be placed in the project files.

7.0 HEALTH AND SAFETY

Observe standard health and safety practices according to the CTO-specific health and safety plan. Monitoring during excavation activities should determine contaminant concentrations and any required personal protective equipment (PPE) that may be necessary.

Suggested minimum protection during soil and rock classification activities in conjunction with field excavations shall include disposable nitrile gloves, steel-toed boots and overboots, safety glasses, hearing protection, and an American National Standards Institute-standard hard hat. Respirators and cartridges may be necessary depending on the contaminant concentrations and shall always be available on site. At no time during classification activities are personnel to reach for debris near machinery that is in operation, place any samples in their mouth, or come in contact with the soils/rocks without the use of gloves.

In addition to the aforementioned precautions, employ the following safe work practices:

Physical Hazards Associated With Soil Classification:

- To avoid lifting injuries associated with large specimens, use the large muscles of the legs, not the back.

- Be wary of uneven terrain to avoid slip/trip/fall conditions.

- To avoid heat/cold stress as a result of exposure to extreme temperatures and PPE, drink electrolyte replacement fluids (1-2 cups/hour is recommended) and, in cases of extreme cold, wear fitted insulating clothing.

- Be aware of restricted mobility due to PPE.

8.0 REFERENCES

American Society for Testing and Materials (ASTM). 2000. *Standard Practice for Description and Identification of Soils (Visual, Manual Procedure)*. D 2488-00. West Conshohocken, PA.

Department of Defense, United States (DoD). 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

Folk, Robert L. 1980. *Petrology of Sedimentary Rocks*. Austin, TX: Hemphill Publishing Company.

Munsell Color Company (Munsell). 2000. *Munsell Soil Color Chart*, (Revised). Baltimore.

9.0 ATTACHMENTS

None.

Attachment 1
Well Construction Form

Well Construction Form

Facility/Project Name:

Well ID.:

Facility License Number:

Type of Well:
Ground Water Monitoring ☐
Piezometer ☐ Injection ☐
Other__________________

Date Well Installed:

Location of well relative to waste source:
Upgradient ☐ Downgradient ☐ Side-gradient ☐ Unknown ☐

Well Installed By:

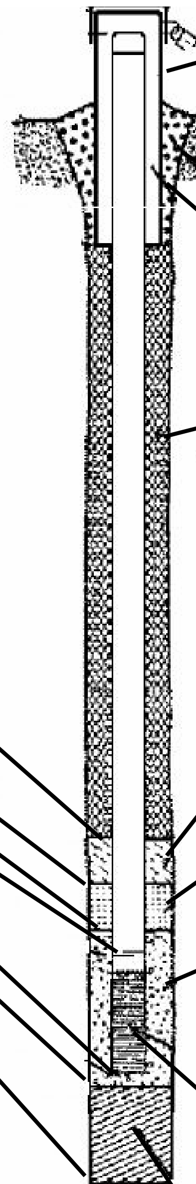
Well Driller License Number:

Geologist:

A. Protective pipe: ft. above grade
B. Well casing, top elevation: ft. MSL
C. Land Surface Elevation: ft. MSL
D. Surface seal, bottom: ft.below grade

12. USCS classification of soil near screen:
GP☐ GM ☐ GC ☐ GW ☐ SP ☐ SM ☐
SC☐ SW☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐
13. Sieve analysis attached? Yes ☐ No ☐
14. Drilling method used: Rotary ☐ HSA ☐
Other:
15. Drilling fluid used:
Water☐ Air ☐ Drilling Mud ☐ None ☐
16. Drilling additives used? Yes ☐ No ☐
Specify:
17: Source of water:

E. Bentonite seal: top ft. (depth)
F. Fine sand: top ft. (depth)
G. Filter pack: top ft. (depth)
H. Screen joint top: ft. (depth)
I. Well bottom: f t. (depth)
J. Filter pack: bottom ft. (depth)
K. Borehole: bottom . ft.(depth)
Borehole diameter: in.



1. Cap and lock? ☐ Yes ☐ No
2. Protective cover pipe:
   a. Inside diameter: in.
   b. Length: ft.
   c. Material: *Steel* ☐ *Other*
3. Surface seal: *Bentonite* ☐ *Concrete* ☐
   Other:
4. Material blw. well casing and protective pipe:
   Bentonite ☐ *Annular space seal* ☐
   Other:
5. Annular space seal: *(Manufacturer name)*
   a. Granular bentonite ☐
   b. Bentonite/Cement slurry ☐
      % bentonite ……. Bentonite/cement grout ☐
      Lbs/gal mud weight … bentonite slurry ☐
   c. How installed: *Tremie* ☐ *Tremie pumped* ☐
      Gravity ☐
6. Bentonite seal: *(Manufacturer, product name)*
   Bentonite granules ☐
   ☐ *¼ in.* ☐ *3/8 in.* ☐ *½ in.* *Bentonite pellets* ☐
   Other:
7. Fine sand material: *(Manufacturer, product name, mesh size)*
   Volume added: ft^3
8. Filter pack material: *(Manufacturer, product name, mesh size)*
   Volume added: ft^3
9. Well casing: Flush-threaded Sch 40 PVC☐
   Flush-threaded Sch 80 PVC☐
   Other:
10. Screen material:
    a. Screen type: factory cut ☐ continuous slot ☐
       Other:
    b. Manufacturer:
    c. Slot size: 0. in.
    d. Slotted length: ft.
11. Backfill material: *or* None ☐

CERTIFICATION:
I hereby certify that the information on this form is true and correct to the best of my knowledge:

____
(Signature)

____
(Company Name)

Attachment 2
Soil Boring Log

ENSAFE

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION
	DRILLING METHOD:		BORING NO.
			SHEET OF
	SAMPLING METHOD:		DRILLING
			START / FINISH
	WATER LEVEL		TIME / TIME
	TIME		
	DATE		DATE / DATE
DATUM / ELEVATION	CASING DEPTH		

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT SAMPLER	VAPOR CONCENTRATIONS (PPM)	DEPTH IN FEET	SOIL GRAPH	SURFACE CONDITIONS:
						0		
						1		
						2		
						3		
						4		
						5		
						6		
						7		
						8		
						9		
						0		
						1		
						2		
						3		
						4		
						5		
						6		
						7		
						8		
						9		
						0		

DRILLING CONTR. ______

BY ______ DATE ______ CHK'D BY ______

Attachment 3

Well Development Record

WELL DEVELOPMENT LOG

PROJECT	WELL NO.	SITE	PREPARED BY

METHOD		
OVERPUMPAGE ☐ BAILER ☐ SURGE BLOCK ☐ AIR LIFT ☐ OTHER ________	INITIAL WATER LEVEL FINAL WATER LEVEL	REMARKS:

CAPACITY OF CASING (GALLONS/LINEAR FOOT)	VOLUME BETWEEN CASING AND HOLE (GALLONS/LINEAR FOOT) (ASSUMING 40% POROSITY)
1” - 0.012 2” - 0.16 4” - 0.65 6” - 0.1.47	1” CASING AND 2” HOLE - 0.013 2” CASING AND 6” HOLE - 0.52 2” CASING AND 8” HOLE - 0.98 4” CASING AND 10” HOLE - 1.37 4” CASING AND 12” HOLE - 2.09

HOLE DIAMETER d_h =

WELL CASING INSIDE DIAMETER d_wID =

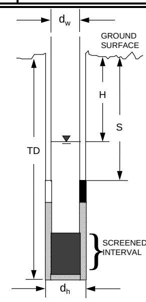
OUTSIDE DIAMETER d_wOD = _____

DEPTH TO: WATER LEVEL H =

BASE OF SEAL S = _____

BASE OF WELL TD =

EST. FILTER PACK POROSITY P = _____



WELL VOLUME CALCULATION :

$$\text{CASING VOLUME} = V_c = \Pi\left(\frac{d_w ID}{2}\right)^2 (TD - H) = 3.14\left(\frac{\_\_\_}{2}\right)^2 (\_\_\_\_ - \_\_\_\_) = \_\_\_\_\_\_$$

$$\text{FILTER PACK PORE VOLUME} = V_f = \Pi\left[\left(\frac{d_h}{2}\right)^2 - \left(\frac{d_w OD}{2}\right)^2\right](TD - (S \text{ or } H^*))(P) = \_\_\_\_\_\_$$

$$(^* \text{if } S > H, \text{use } S; \text{if } S < H, \text{use } H)$$

$$= 3.14\left[\left(\frac{\_\_\_}{2}\right)^2 - \left(\frac{\_\_\_}{2}\right)^2\right](\_\_\_\_ - \_\_\_\_)(\_\_\_\_) = \_\_\_\_$$

$$\text{TOTAL WELL VOLUME} = VT = Vc + Vf = \_\_\_\_ + \_\_\_\_ = \_\_\_\_\_\_ \text{ ft.}^3 \times 7.48 = \_\_\_\_\_\_ \text{ gal.}$$

DEVELOPMENT LOG:					CUMULATIVE WATER REMOVED	WATER QUALITY						COMMENTS
DATE	TIME BEGIN/END	METHOD	ELAPSED TIME	FLOW RATE (gpm)	GALLONS	pH	TEMP	CONDUCTIVITY	D.O. *	REDOX	TURBIDITY	

* = Dissolved Oxygen

Standard Operating Procedure SOP-3-13
Monitoring Well Development

Monitoring Well Development

Procedure 3-13

1.0 Purpose and Scope

1.1 This standard operating procedure (SOP) describes the procedures used for developing newly installed monitoring wells and/or redeveloping existing wells.

1.2 The purpose of well development is to remove interferences from a well to provide better connection between the well and the formation, to improve pumping performance of the well, and to be able to collect more representative information from the well (e.g., samples, test results, etc.). Proper well development will:

- Remove drilling residuals (e.g., water, mud) from the borehole and surrounding formations;
- Improve or restore hydraulic conductivity of the surrounding formations which may have been disturbed during the drilling process;
- Remove residual fines from the well screen and sand pack (filter pack) materials, thus reducing turbidity of groundwater and permitting the collection of more representative groundwater samples.

1.3 There may be circumstances where well development is not desirable, for example, in the presence of non-aqueous phase liquids (NAPL) or other significant contamination if development could worsen the contaminant impact. If NAPL begins to intrude during development, the development process will be halted. This situation will be considered a cause for sample modification requiring approval by the CTO Manager and other stakeholders, as applicable.

1.4 The applicable well development procedures for a particular site may be subject to State or local regulatory requirements. In all cases, the project team should consult their local regulatory requirements and document the selected well development procedure in the project-specific Sampling and Analysis Plan (SAP). For project-specific information refer to the SAP, which takes precedence over these procedures.

1.5 This procedure is the Program-approved professional guidance for work performed by Resolution Consultants under the Comprehensive Long-Term Environmental Action Navy (CLEAN) contract (Contract Number N62470-11-D-8013).

1.6 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review.

2.0 Safety

2.1 The health and safety considerations for the work associated with this SOP, including both potential physical and chemical hazards, will be addressed in the project Health and Safety Plan (HASP). In the absence of a HASP, work will be conducted according to the Contract Task Order (CTO) SAP and/or direction from the Site Safety Officer (SSO).

2.2 Monitoring well development may involve chemical hazards associated with potential contaminants in the soil or aquifer being characterized and may involve physical hazards associated with use of well development equipment.

3.0 Terms and Definitions

None.

4.0 Interferences

4.1 Equipment/materials used for development may react with the groundwater during development. Appropriate development equipment has been selected for the anticipated condition of the groundwater.

4.2 Appropriate development methods such as using a surge-block to flush suspended fines in the groundwater in and out of the well screen can improve the yield of wells and improve their potential to be developed successfully. However, the effectiveness of development can be significantly reduced in wells that do not yield sufficient water to allow this flushing to take place.

4.3 For formations with a significant content of fine-grained materials (silts and clays), or wells with improperly sized screens, it may not be possible to reduce turbidity to commonly acceptable levels. Possible solutions may include collecting a sample even if excessively turbid, or installing a replacement well.

4.4 Development itself disturbs the surrounding formation and disrupts equilibrium conditions within the well. Groundwater samples will not be collected until a minimum of 24 hours after a well is developed to allow conditions to stabilize. For sites with fine-grained formations (silts and clays) and highly sorptive contamination, a longer time period between development and sampling should be considered.

5.0 Training and Qualifications

5.1 Qualifications and Training

The individual executing these procedures must have read, and be familiar with, the requirements of this SOP.

5.2 Responsibilities

5.2.1 The **CTO Manager** is responsible for ensuring that well development activities comply with this procedure. The **CTO Manager** is responsible for ensuring that all personnel involved in well development shall have the appropriate education, experience, and training to perform their assigned tasks.

5.2.2 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.

5.2.3 The **Field Manager** is responsible for ensuring that all well development activities are conducted according to the either this procedure or the applicable procedure presented in the project-specific SAP.

5.2.4 **Field sampling personnel** are responsible for the implementation of this procedure.

5.2.5 The field sampler and/or task manager is responsible for directly supervising the well development procedures to ensure that they are conducted according to this procedure and for recording all pertinent data collected during sampling.

6.0 Equipment and Supplies

6.1 This equipment list was developed to aid in field organization and should be used in planning and preparation. Depending on the site-specific requirements and the development method selected, additional or alternative material and equipment may be necessary. In addition, for sites where groundwater is expected to be contaminated, the materials to be placed down the well and in contact with groundwater should be evaluated so that they are compatible with the chemical conditions expected in the well.

6.2 Equipment and materials used for well development may include, but is not limited to:

Well development equipment

- Surge block

- Disposable Teflon bailers, appropriate to the diameter of the well(s): 1-inch to 1.5-inch for 2-inch inside diameter (ID) monitoring wells.
- Watterra® footvalve
- Electric submersible pump
- 12-volt power source for electric pump
- High density polyethylene (HDPE) tubing appropriately sized for Watterra® footvalve and/or electric submersible pump
- Drums or containers for storage of purge water
- Nephelometer to measure turbidity
- Multi-parameter water quality meter(s) to measure temperature, pH, conductivity, dissolved oxygen (DO), oxidation reduction potential (ORP)
- Instrument calibration solutions
- Water level meter
- Oil/water interface probe

General equipment

- Project-specific plans including the site-specific HASP and SAP
- Field notebook/field forms/site maps
- Indelible markers/pens
- 5-gallon buckets

Equipment decontamination supplies (refer to SOP 3-06, Equipment Decontamination)

- Health and safety supplies, including personal protective equipment (PPE)
- Appropriate hand tools
- Keys or combinations to access monitoring wells
- Distilled/deionized water supply
- Disposable bailer string (polypropylene)
- Plastic trash bags

7.0 Procedure

Development generally consists of removing water and entrained sediment from the well until the water is clear (to the extent feasible) and the turbidity is reduced, which indicates the well is in good hydraulic connection with the surrounding formation. In addition to simply removing water, development can be improved when flushing through the well screen and gravel pack takes place in both directions, that is, both into the well and into the formation. This action breaks down sediment bridges that can occur in the formation or sand pack, which reduce the connection between the well and the formation

7.1 General Preparation

- All down-well equipment should be decontaminated prior to use and between well locations in accordance with SOP 3-06, Equipment Decontamination
- Although equipment is decontaminated between well locations, if wells are known or suspected to be contaminated based on observations during well installation, it is recommended that well development be conducted in order from the least contaminated to the most contaminated well to minimize the chances of cross-contamination.
- Management of investigation-derived waste (IDW), including development purge water and miscellaneous expendable materials generated during the development process, will be conducted in accordance with SOP 3-05, IDW Management.

- Prior to accessing the well, the wellhead should be cleared of debris and/or standing water. Nothing from the ground surface should be allowed to enter the well.
- The depth to water and total well depth should be measured with a water level meter and recorded in the field logbook or on a Well Development Record (Attachment 1). This information will be used to calculate the volume of standing water (i.e., the well volume) within the well, and plan the specific details of the well development. If wells are suspected to contain NAPL, an oil/water interface probe should be used to measure liquid levels and depth to bottom of the well.
- Permanent monitoring wells will be developed no sooner than 24 hours after well installation is completed in order to allow well completion materials to set properly.

7.2 Monitoring Well Development Procedures

Generally, development will begin by gently surging the well with a surge block or bailer as described in Sections 7.2.1 and 7.2.2, respectively. Surging can become more vigorous as development progresses but initially the well must be gently surged to allow material blocking the screen to become suspended without damaging the well. Next, a bailer can be used to remove the sediment settled at the base of the well. A bailer, Watterra® pump, or electric submersible pump will then be used to purge the well, per Sections 7.2.2, 7.2.3, or 7.2.4, respectively. The well will be purged until the removed water becomes less turbid or per the requirements of the project-specific SAP, or State or local requirements. At this point the well will be surged again with a surge block or bailer. The well can be surged more vigorously at this point. After surging, the well will be purged again until the turbidity once again decreases. The surge/purge cycle should be completed at least three times during the development process. After the last surge, the well will be purged until the development completion criteria outlined in 7.3.2 or per the project-specific SAP are met.

7.2.1 Surge Block

The default method of well development is the use of a surge block in conjunction with pumping or bailing to remove sediment-laden water.

- The construction of the surge block must be appropriate for the diameter of the well. The surge block must be mounted on rods or other stiff materials to extend it to the appropriate depths and to allow for the surge block to be moved up and down in the well.
- Insert the surge block into the well and lower it slowly to the screened or open interval below the static water level. Start the surge action by slowly and gently moving the surge block up and down in the well. A slow initial surging, using plunger strokes of approximately 1 meter or 3 feet, will allow material which is blocking the screen to separate and become suspended.
- After 5 to 10 plunger strokes, remove water from the well using a separate bailer (Section 7.2.2) or pumping techniques (Sections 7.2.3 or 7.2.4). The returned water should be heavily laden with suspended fines. The water will be discharged to 5-gallon buckets or 55-gallon drums to be managed per the requirements presented in the project-specific SAP.
- In some cases, the bailer or Watterra® foot valve can act as a surge block, flushing water in and out of the well screen as groundwater is removed.
- Repeat the process of surging and pumping/bailing. As development continues, slowly increase the depth of surging to the bottom of the well screen. Surging within the riser portion of the well is neither necessary nor effective.

7.2.2 Bailer

- Tie a string or other cable securely to the bailer. Lower it to the screened or open interval of the monitoring well below the static water level.
- The bailer may be raised and lowered repeatedly within the screened interval to attempt to simulate the action of a surge block by pulling fines through the well screen, and pushing water out into the formation to break down bridging.

- With the bailer full of water, remove it from the well and discharge the water into 5-gallon buckets or 55-gallon drums to be managed per the requirements presented in the project-specific SAP.
- The Watterra® system (Section 7.2.3) or electric submersible pump (Section 7.2.4) may be used as a complementary development method to the bailer, especially when removal of additional water at a faster rate is beneficial.
- Continue alternately surging and bailing, monitoring the purge water periodically (Section 7.3.1) until development completion criteria are met (Section 7.3.2).

7.2.3 Watterra® system

- Attach high-density polyethylene (HDPE) tubing to the decontaminated Watterra® pump foot valve
- Lower the foot valve and tubing assembly near the bottom of the well.
- Lift and lower the tubing to allow water to enter the Watterra® foot valve and travel up the tubing and discharge the water into 5-gallon buckets or 55-gallon drums to be managed per the requirements presented in the project-specific SAP.
- The lifting and lowering action of the Watterra® sysem will cause some surging action to aid in breaking up fine material in the surrounding formation.
- A bailer (Section 7.2.2) may be used as a complementary development method to the Watterra® system, especially during the initial stages of development when a high volume of sediment may be required to be removed.
- An electric submersible pump (Section 7.2.4) may also be used as a complementary development method to the Watterra® system, especially when more volume of water is desired to be pumped or the turbidity criteria cannot be met due to the surging action of the Watterra® system.
- Continue alternately surging and pumping, monitoring the purge water periodically (Section 7.3.1) until well development completion criteria are met (Section 7.3.2).

7.2.4 Electric Submersible Pump

- Attach HDPE tubing to the decontaminated electric submersible pump.
- Lower the pump and tubing assembly near the bottom of the well, at least a few inches above the well total depth.
- Begin pumping, discharging the water into 5-gallon buckets or 55-gallon drums to be managed per the requirements presented in the project-specific SAP.
- Continue alternately surging and pumping, monitoring the purge water discharge periodically (Section 7.3.1) until well development completion criteria are met (Section 7.3.2).

7.3 Discharge Monitoring

7.3.1 Monitoring the Progress of Development

The progress of the development is evaluated through visual observation of the suspended sediment load and measurement of the turbidity and other parameters in the purged diischarge water. As development progresses, the water should become clearer, measured turbidity should decrease, and specific capacity (pumping rate divided by drawdown) should stabilize. Water quality parameters, including DO, conductivity, ORP, pH, temperature, and turbidity may be measured and recorded periodically to determine the progress of development using the criteria outlined in Section 7.3.2 or per the project-specific SAP. Water quality parameters should be measured on each well volume removed.

7.3.2 Completion of Development

The well will be considered developed when the following criteria are met or per the criteria set forth in the project-specific SAP:

- A minimum of three times the standing water volume in a well (to include the well screen and casing plus saturated annulus, assuming 30 percent porosity) is removed.

- Groundwater parameters for three consecutive standing water volumes are within the following:
    - pH – within ± 0.2 units
    - Specific conductivity – within ± 3%
    - ORP – within ± 10 mV
    - Temperature – within ±1 degree Celsius
    - Turbidity – at or below 10 nephelometric turbidity units (NTU) or within ± 10% if above 10 NTU.
- The sediment thickness remaining within the well is less than 1 percent of the screen length or less than 30 millimeters (0.1 ft) for screens equal to or less than 10 feet long.

Dissolved oxygen (DO) readings may be recorded but DO readings will not be used as development completion criteria because DO may not stabilize.

If the well has slow groundwater recharge and is purged dry, the well will be considered developed when bailed or pumped dry three times in succession and the turbidity has decreased, or per the requirements set forth in the project-specific SAP. Water quality parameters may be recorded if feasible using the flow-through cell.

If any water is added to the well's borehole during development or drilling, three times the volume of water added will also be removed during well development, or per the requirements set forth in the project-specific SAP.

7.4 Development of Wells with Low Yield

Water is the primary mechanism to remove fines and flush water through the gravel pack for effective development. Therefore, development can be a challenge in wells that do not yield sufficient water to recharge when water is removed. However, often these wells are the most in need of development to improve their performance as they are typically installed in low permeability formations with a high content of fines. Development of these wells can improve their yield.

The surging portion of the development can be successfully performed in a well with standing water regardless of its yield. It is the subsequent removal of fine materials that is hindered when insufficient water is recharged to the well. When wells go dry or drawdown significantly during development, development can be performed intermittently, allowing sufficient water to recharge prior conducting the next stage of surging. These intermittent procedures can take place hours or even days apart, depending on project-specific time constraints.

7.5 Wells containing NAPL

Additional care should be taken when planning development of wells that contain NAPL. If the NAPL is flammable, there are health and safety as well as handling issues to consider. If NAPL in excess of a persistent sheen is noted, the recharge rate will be evaluated through hand bailing. In most cases, it is generally preferable to remove NAPL by bailing to the extent practical prior to performing development. Groundwater parameters, excluding turbidity, will not be collected during well development if NAPL or excessive sheen is noticed in the purged water during development to ensure the meter probes are not fouled or destroyed. Well development will be halted.

Development by surging or pumping the well dry can result in the spreading of NAPL vertically in the soil column around the well. These methods can be used, if information exists describing the vertical thickness of the NAPL smear zone around the well, and if the methods do not result in mounding or drawdown that exceeds this thickness. Alternate methods such as bailing may also be used, but any method should not allow the well to be pumped dry or result in significant drawdown that would spread the NAPL vertically.

7.6 Temporary Well Points

For certain projects, temporary well points (TWPs) may be installed to collect groundwater samples at a site. Since no sand pack, bentonite chips, or bentonite grout are generally used in the construction of the TWPs, development can proceed as soon as sufficient water has entered the well to static conditions. Due to the small diameter of these wells, generally ¾-inch to 1-inch ID, development will be performed using either a small diameter (0.5-inch) bailer and/or a peristaltic pump with dedicated tubing. The TWPs will have minimal water column and may purge dry during development. However, attempts will be made to remove fines from the well prior to sampling. Purging and sampling may occur as soon as approximately 80% of the static water has re-entered the TWP, or per the requirements set forth in the project-specific SAP.

8.0 Quality Control and Assurance

8.1 Field personnel will follow specific quality assurance (QA) guidelines as outlined in the project-specific SAP.

8.2 Quality control (QC) requirements are dependent on project-specific sampling objectives. The project-specific SAP will provide requirements for equipment decontamination (frequency and materials) and IDW handling.

9.0 Records, Data Analysis, Calculations

9.1 All data and information (e.g., development method used) must be documented on field data sheets (Attachment 1) or within site logbooks with permanent ink. Data recorded may include the following:

- Well Location
- Weather conditions
- Date and Time
- Purge Method
- Reading/measurements obtained

10.0 Attachments or References

Attachment 1 – Well Development Record

SOP 3-05, *IDW Management*.

SOP 3-06, *Equipment Decontamination*.

Author	*Reviewer*	*Revisions (Technical or Editorial)*
Shawn Dolan Senior Scientist	Chris Barr Program Quality Manager	Rev 0 – Initial Issue (June 2012)

Attachment 1
Well Development Record

WELL DEVELOPMENT & GROUNDWATER SAMPLING FORM

DATE:	JOB NUMBER:	EQUIPMENT (Make/Model #/Serial #):
PROJECT:	EVENT:	/ /
WELL ID:	LOCATION:	/ /
WEATHER CONDITIONS:	AMBIENT TEMP:	/ /
REVIEWED BY:	PERSONNEL:	/ /

WELL DIA:	**WELL DEVELOPMENT**	
TOTAL DEPTH from TOC (ft.):	START:	FINISH:
DEPTH TO WATER from TOC (ft.):	VOLUME PURGED (gal):	
LENGTH OF WATER COL. (ft.):	**GROUNDWATER SAMPLING**	
1 VOLUME OF WATER (gal):	START:	FINISH:
3 VOLUMES OF WATER (gal):	VOLUME PURGED (gal):	
	ANALYSIS:	

WELL DEVELOPMENT PARAMETERS		GW SAMPLING PARAMETERS	
Temperature:	± 1.0° C	Temperature:	± 0.2° C
pH:	± 0.5 standard units	pH:	± 0.2 standard units
Specific Conductance:	± 10% of the past measurement	Specific Conductance:	± 5% of the past measurement
Turbidity:	relatively stable	DO:	≤ 20% saturation
		ORP:	± 10 millivolts
		Turbidity:	≤ 10 NTU

IN-SITU TESTING

Circle one: DEVELOPMENT SAMPLING ☐ Bailer ☐ Pump Description:

Time (hh:mm):												
pH (units):												
Conductivity (mS/cm):												
Turbidity (NTU):												
DO (mg/L): YSI 556												
DO (mg/L): YSI 550												
Temperature (C^o):												
ORP (mV):												
Volume Purged (gal):												
Depth to Water (ft):												
								Well Goes Dry While Purging ☐				

SAMPLE DATA

☐ Bailer ☐ Pump Description:

Sample ID	Date (m/d/y)	Time (hh:mm)	Bottles (total to lab)	Filtered (0.45 µm)	Remarks

Purging/Sampling Device Decon Process:

COMMENTS:

Purge water placed in drum#_______________

Standard Operating Procedure SOP-3-14
Monitoring Well Sampling

1.0 PURPOSE

This standard operating procedure (SOP) describes the monitoring well sampling procedures. If there are procedures from Resolution Consultants, state and/or federal that are not addressed in this SOP and are applicable to monitoring well sampling, then those procedures may be added as an appendix to the project-specific sampling and analysis plan (SAP).

2.0 SCOPE

This procedure shall serve as management-approved professional guidance consistent with protocol in the Uniform Federal Policy-Quality Assurance Project Plan (DoD 2005). As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment during unforeseen circumstances. Deviations from this procedure while planning or executing planned activities must be approved by either the Contract Task Order (CTO) Manager or the Quality Assurance (QA) Manager, and documented.

3.0 DEFINITIONS

None.

4.0 RESPONSIBILITIES

The CTO Manager is responsible for ensuring that these standard groundwater sampling activities are followed during projects. The CTO Manager or designee shall review all groundwater sampling forms for completeness. The CTO Manager is responsible for ensuring that all personnel involved in monitoring well sampling shall have the appropriate education, experience, and training to perform their assigned tasks as specified in Chief of Naval Operations Instruction 5090.1c (DON 2007). The QA Manager or Technical Director is responsible for ensuring overall compliance with this procedure. The Field Manager is responsible for ensuring that all project field staff follow these procedures.

5.0 PROCEDURES

5.1 Site Background Information

Establish a thorough understanding of the purposes of the sampling event prior to field activities. Conduct a review of all available data obtained from the site and pertinent to the water sampling. Review well historical data including, but not limited to, well locations, sampling history, purging rates, turbidity problems, previously used purging methods, well installation methods, well completion records, well development methods, previous analytical results, presence of immiscible phases, historical water levels, and general hydrogeologic conditions.

To help minimize the potential for cross-contamination, well purging, sampling, and water level measurement collection shall proceed from the least contaminated to the most contaminated as indicated in previous analytical results or expected contaminant transport. This order may be changed in the field if conditions warrant it, particularly if dedicated sampling equipment is used. A review of prior sampling procedures and results may also identify which purging and sampling techniques are appropriate for the parameters to be tested under a given set of field conditions.

5.2 Groundwater Analysis Selection

Establish the requisite field and laboratory analyses prior to water sampling. Determine the appropriate and required types and numbers of QA/quality control (QC) samples to be collected (if not specified in the SAP), as well as the type and volume of sample preservatives, the number of sample shipping containers (e.g., coolers), and the quantity of ice or other chilling materials. The sampling personnel shall ensure that the appropriate number and size sample containers are brought to the site, including extras in case of breakage or unexpected field conditions. The analytical requirements for groundwater analyses should be specified in the project-specific work plan or SAP.

5.3 Sampling Methods

The utilized sampling methodology shall allow for the collection of a groundwater sample in as undisturbed a condition as possible, minimizing the potential for volatilization or aeration during collection and transfer to sample containers. A variety of methods exist including submersible pumps, bladder pumps, peristaltic pumps, and bailers. Dedicated tubing should be used if at all possible and sampling equipment should be constructed of inert material consisting of either stainless steel, polyethylene, Teflon, or polyvinyl chloride. The selected pump type must take into account water depth, total depth of well, and the lift capacity of pump — typically available from the pump manufacturer. If depth to water is greater than 50 feet, then the pumps performance curves should be evaluated to ensure a sustained pumping rate can be maintained for continual flow. Sampling materials must be compatible with site contaminants and dedicated tubing should always be used, if possible. The various types of sampling devices, their advantages and disadvantages are described in the following paragraphs.

Bailers

A single- or double-check valve Teflon or stainless steel bailer equipped with a bottom discharging device can be utilized to collect groundwater samples. Bailers have a number of disadvantages, including a tendency to alter the chemistry of groundwater samples due to degassing, volatilization, mixing, and aeration; the possibility of creating high groundwater entrance velocities; differences in operator techniques resulting in variable samples; and difficulty in determining where in the water column the sample was collected. Therefore, bailers should be used for groundwater sampling only when other types of sampling devices cannot be utilized for technical or logistical reasons. The QA Manager or Technical Director must approve the use of bailers for groundwater sampling in advance, or as approved in a SAP.

Bailers must be constructed of materials compatible with the analytes of interest. Use disposable bailers when sampling grossly contaminated sample sources. Lanyards must be made of non-reactive, non-leachable material. They may be cotton twine, nylon, stainless steel, or may be coated with Teflon, Polyethylene or Polypropylene.

Plastic sheeting must be placed around the well so that the bailer lanyard or rope is not in contact with ground. Bailers are lowered into the top of the water column, allowed to fill, and removed. Bailer samples are collected by slowly and gently lowering the bailer down the well until the top of the bailer is below the groundwater surface. Care should be taken to avoid sample disturbance and to minimize aeration of samples or groundwater in the well. It is critical that bailers be slowly and gently immersed into the top of the water column, particularly during final stages of purging, to minimize turbidity and disturbance of volatile organic constituents. Do not allow any bailer to fall freely into the well; minimize contact with the well sides and avoid contact with the bottom since this may allow any attached or settled out sediments to be incorporated into the samples. Retrieve the bailer slowly. Carefully empty groundwater samples directly into the appropriate containers.

New bailer rope should be attached to the bailer between samples and after decontamination, if non-disposable bailers are used. If a bailer was used to purge the well, it may also be used to sample the well and new bailer rope is not required between purging and sampling.

Bladder Pumps

A gas-operated Teflon or stainless steel bladder pump with adjustable flow control and equipped with Teflon-lined tubing can be effectively utilized to collect a groundwater sample and is considered to be the best overall device for sampling inorganic and organic constituents. Operate positive gas displacement bladder pumps in a continuous manner so that they minimize discharge pulsation that can aerate samples in the return tube or upon discharge. If a bladder pump is utilized for the well purging process, the same bladder pump can also be utilized for sample collection after purging is complete.

When using a compressor, take several precautions. First, position any fuel-operated compressor downwind of the well and point of sample collection. Second, ensure the purge water exiting the well is collected into a drum or bucket. Finally, connect the compression hose from the well pump to the control box. Do not connect the compression hose from the compressor to the control box until after the engine has been started.

When all precautions are completed and the engine has been started, connect the compression hose to the control box. Slowly adjust the control knobs so as to discharge water in the shortest amount of time but maintaining a near constant flow. This does not mean that the compressor must be set so as to discharge the water as hard as possible. The optimal setting is one that produces the largest volume of purge water per minute (not per purge cycle) while maintaining a near constant flow rate.

Prior to sampling, adjust the flow or purge rate to yield 100 to 300 milliliters/minute (mL/min). Avoid settings that produce pulsating streams of water instead of a steady stream. Operate the pump at this low flow rate for several minutes to ensure that the groundwater being sampled is being withdrawn at a low extraction rate. The flow rate of 100 mL/min must be obtained so as not to cause fluctuation in pH, pH-sensitive analytes, and the loss of volatile constituents. Higher flow rates can be used once the samples for the analysis of volatile components have been collected. At no time shall the sample flow rate exceed the flow rate used while purging. Preserve the natural conditions of the groundwater, as defined by pH, dissolved oxygen (DO), specific conductance, temperature, turbidity, and oxidation/reduction potential (ORP).

For those samples requiring filtration, it is recommended to use in-line high capacity filter after all nonfiltered samples have been collected.

Passive Diffusion Bags

Passive diffusion bag samplers are bags comprised of low-density polyethylene plastic and containing analyte-free water, preferably with no headspace. The bags are deployed, with stainless steel weights, to the desired sample interval and are allowed to equilibrate with the water at the point of deployment in the well. A deployment period of a minimum of 14 days is recommended to ensure equilibration prior to removal.

After 14 days, the bags are removed and opened with a puncture device or other cutting implement and the contents transferred to containers for sampling or field measurement.

Peristaltic Pumps

A peristaltic pump is a type of positive displacement pump that lifts the water in a well by vacuum. The sample tubing is connected to flexible silicon hose fitted between rotating cams inside the pump casing that compresses the flexible tube as the rotor turns, creating a vacuum within the tube which lifts the water. In peristaltic pumps, no moving part of the pump is in contact with the water, thus forgoing the need for pump decontamination. The pumps are simple to operate, generally trouble free and quite inexpensive requiring only a 12-volt battery to power.

Peristaltic pumps may use a vacuum-trap method to collect non-volatile organic compound (VOC) samples. In this method, a pre-cleaned "transfer bottle" is connected between the peristaltic pump and the Teflon intake tubing installed in the well. As the pump evacuates air from the transfer bottle, the vacuum created causes the transfer bottle to fill with groundwater avoiding water contact with the flexible silicon tubing. The water aliquot in the transfer bottle is used to fill the appropriate sample containers.

Using a peristaltic pump to collect samples for VOCs requires special technique. The intake tube in the well is allowed to fill, the pump is shutoff and the tubing is retrieved from the well. In some cases, an inline valve is placed before the pump and is closed to ensure the sample does not drain from the intake tubing while it is being withdrawn from the well. Alternatively, the intake tubing may be crimped to retain the water. Sample containers should be filled by draining the water from the bottom of the intake tube by either breaking the vacuum or reversing the pump flow direction. Special care should be taken if the pump is reversed so that water that contacted the silicon tubing is not collected as part of the sample or that water from the purge collection container is not siphoned into sample container. Groundwater contact with the pump's silicon tubing should be avoided as the tubing may strip low level VOCs from the sample or components of the silicon tubing may interfere with the sampling results.

If depth to water in the well is greater than 28 to 30 feet, the peristaltic pump will not lift the water and an alternate sampling device will be necessary.

Submersible Pumps

When operated under low-flow rate conditions (mL/min or less), submersible pumps are as effective as bladder pumps in acquiring samples for volatile organic analysis as well as other analytes. The submersible pump must be specifically designed for groundwater sampling (i.e., pump composed of stainless steel and Teflon, sample discharge lines composed of Teflon) and must have a controller mechanism allowing the required low flow rate. Ensure the purge water exiting the well is collected into a drum or bucket. Adjust the pump rate so that flow is continuous and does not pulsate to avoid aeration and agitation within the sample discharge lines. Run the pump for several minutes at the low flow rate used for sampling to ensure that the groundwater in the lines was obtained at the low flow rate. Higher pumping rates than 100 to 300 mL/min may be used when collecting samples to be analyzed for non-volatile constituents, if significant drawdown does not occur.

5.4 Groundwater Sampling Procedures

5.4.1 Measurement of Static Water Level and Purge Volume Calculations

Verify the identification of the monitoring well by examining markings, sign plates, placards or other designations. Remove the well cover and remove all standing water around the top of the well casing (manhole) before opening the well cap. Inspect the exterior protective casing of the monitoring well for damage and document the results of the inspection if there is a problem. It is recommended that you place a protective ground covering (like plastic sheeting) around the well head. Replace the covering if it becomes soiled or ripped. Inspect the well lock and determine whether the cap fits tightly. Replace the cap if necessary. Document all observations in the logbook.

Use an electronic probe to determine the water level. Decontaminate all equipment before use per SOP 3-06, Equipment Decontamination. Measure the depth to groundwater from the top of well casing to the nearest 0.01 foot and always measure from the same reference point or survey datum mark on the well casing. If there is no reference mark, measure from the north side of the casing. Record the measurement and the reference point in the logbook.

The device used to measure the water level surface and depth of the well shall be sufficiently sensitive and accurate in order to obtain a measurement to the nearest 0.01 foot reliably. An electronic water level meter will usually be appropriate for this measurement; however, when the groundwater within a particular well is highly contaminated, an electronic interface probe should be used to determine the presence of light, non-aqueous phase liquids (LNAPLs) and/or dense, non-aqueous phase liquids (DNAPLs). Measurements should be from the top and the bottom of the product. Water levels containing LNAPL must be corrected for density effects to accurately determine the elevation of the water table.

If well development or drilling data indicates a potential for immiscible phase layers in groundwater, complete the following steps for detecting the presence of LNAPL and DNAPL before the well is evacuated for conventional sampling:

1. Carefully remove the well cap and release any pressure that may have accumulated from possible gasses or pressure changes between the inside and outside of well.

2. Sample the headspace in the wellhead immediately after the well is opened for organic vapors using an organic vapor analyzer such as a photoionization detector or flame-ionization detector, and record the measurements in the logbook.

3. Lower an interface probe into the well to determine the existence of any immiscible layer(s), LNAPL and/or DNAPL, and record the measurements in the logbook.

4. Confirm the presence or absence of an immiscible phase by slowly lowering a clear bailer to the appropriate depth, then visually observing the results after sample recovery.

If the well contains an immiscible phase, it may be desirable to sample this phase separately. It may not be meaningful to conduct water sample analysis of water obtained from a well containing LNAPLs or DNAPLs. Consult the CTO Manager and QA Manager or Technical Director if this situation is encountered.

5.4.2 Water Column Determination

If the total well depth is not available, the well should be sounded using a decontaminated weighted tape. A water level probe should not be used for sounding a well as the meter will be short circuited due to excessive head pressures overcoming the probe's seals. Note that wells which have not been sampled for a long period could be sufficiently silted-in to require re-development prior to sampling. It is therefore recommended that sufficient planning be included in a work activity to allow at least 24 hours to sound any wells to be sampled and redevelop for which a layer of silt at the bottom of the well screen may be present.

Subtract the depth to the top of the water column from the total well depth to determine the length of the water column. Calculate the total volume of water in gallons in the well using the following equation:

$$v = (0.041)d^2h$$

Where:
v = volume in gallons
d = well diameter in inches
h = height of the water column in feet

The total volume of water in the well may also be determined with the following equation by using a casing volume per foot factor (gallons per foot of water) for the appropriate diameter well:

$$v = (\text{gallons per foot of water})h$$

Where:
v = volume in gallons
h = height of the water column in feet

Table 1
Well Purging Volumes for Variable Well Casing Diameters

Casing Internal Diameter (inches)	Approximate Gallons per Foot of Water
0.75	0.02
1	0.04
1.25	0.06
2	0.16
3	0.37
4	0.65
5	1.02
6	1.47
12	5.88

5.5 Low Flow Purging and Water Quality Parameter Monitoring

The low-flow purging is the method of choice for collecting representative groundwater and offers the advantage over traditional three-well volume purges in that it generates minimal investigation-derived waste and commonly generates a higher quality groundwater sample. This method is based on the procedure described in *Low-Flow (Minimal Drawdown), Ground-Water Sampling Procedures*, (Puls and Barcelona, USEPA, April 1996).

This procedure is typically accomplished by measuring field parameters at periodic intervals during purging with a flow-through cell container that allows field personnel to constantly monitor field water quality parameters such as temperature, pH, dissolved oxygen, and specific conductance. Other techniques or containers can be used to collect samples for periodic measurements, provided that periodic and representative samples can be collected.

Low-flow purging does not require the calculation of the water volume in the well, since purging is based solely on indicator parameter stabilization. Instead, the volume of the pump and discharge tubing are used to determine field measurement frequency and/or the minimum purge volume. Pump chamber or bladder volumes can be obtained from the manufacturer. Volumes of the sample tubing can be calculated or taken from Table 2.

Table 2
Equipment Volumes for Variable Tube Diameters

Discharge Tubing Volumes

Tubing Diameter (inches)	Volume per foot
1/2 OD and 3/8 ID	20 mL
3/8 OD and 1/4 ID	10 mL
1/4 OD and 1/8 ID	5 mL

Notes:
OD = outer diameter
ID = inner diameter
mL = milliliter

Well casing volumes should still be calculated and recorded on field information forms in the event parameter stabilization is not achieved after a three-casing-volume purge (see following subsection).

Sampling equipment volumes are calculated and recorded for use in determining the frequency of field measurements. Depending on the equipment configuration, calculate and record the volume of the pump and sample tubing using the methodology previously described (the volumes are typically converted to liters). The frequency of field readings is based on the time required to purge at least one volume of the pump and tubing system. For example, a pump and tubing volume of 500 mL purged at a rate of 250 mL/min will be purged in 2 minutes; readings should be at least 2 minutes apart.

The purging process removes sufficient water from within the well screen zone to obtain a sample that is representative of actual aquifer conditions adjacent to the well. The pump intake location is established for dedicated pumps. For non-dedicated pumps, the intake is placed within the screened interval, typically in the center of the screen. If the water column in the screen is shorter than the overall screen length, the pump should be placed lower in the screen but no lower than about 6 to 12 inches from the bottom of the screen to avoid picking up any settled solids in the well.

Typically, a pumping rate less than 1,000 mL/min is used and it is dependent on site-specific conditions. The pumping rate should be established based on where drawdown achieves stabilization and not an arbitrary drawdown limit. Excessive pumping rates (more than 1,000 mL/min) should be avoided so as to avoid turbidity as a result of aquifer shearing and water cascading through the well screen and potentially stripping VOCs. Flow rate is determined by measuring the time it takes to fill a calibrated container. Drawdown is monitored by measuring the water level below the top of the well casing with a water level indicator or similar device (e.g., transducer) while pumping. Flow rates and drawdown are recorded on a field logbook, field data form or with a data logger.

- Measure water level prior to initiating purging;
- Calculate well volumes, if required by permit;
- Calculate sampling system volume and determine indicator parameter measurement frequency;
- Connect the flow-through cell to the discharge tube from the pump;
- Begin purge at a rate of 100 to 200 mL/min (or at a rate determined from prior events);
- Check drawdown with a water level monitor while pumping;

- If drawdown stabilizes quickly, increase the pumping rate in increments of 100 mL/min until drawdown increases, then reduce the rate slightly after a few minutes to achieve a stable pumping water level;

- If the water level continues to drop, reduce purge rate by 100 mL/min increments until the water level stabilizes;

- Once water level stabilization is achieved, proceed to indicator parameter stabilization. Attempts should be made to avoid purging well to dryness, which can usually be accomplished by slowing the purge rate. If after continued reductions in the flow rate the well goes dry, the well should be sampled immediately after a sufficient volume of water has recovered in the well.

- If, after three well volumes have been removed, the chemical parameters have not stabilized according to the above criteria, the sampling team may elect to collect a sample.

Parameter Stabilization

Parameter stabilization ensures that the well is adequately purged and sampled groundwater is representative of formation water. In order to determine when a well has been adequately purged, samplers should:

- Monitor pH, specific conductance, DO, ORP, temperature, and turbidity of the groundwater removed during purging.

- Ensure stabilization is achieved by measuring three consecutive measurements, no sooner than 3 to 5 minutes apart, for the six parameters and criteria listed in Table 3 are achieved.

- Observe and record the water level drawdown.

- Record the purge rate and note the volume of water removed if required by guidance or permit.

Make every attempt to satisfy the parameter criteria in Table 3. Match the pumping rate with the recharge rate of the well by ensuring water level in well is stable before evaluating the purging criteria and document on the groundwater sampling form.

Table 3
Water Quality Parameters and Stability Criteria

Parameter	Stability Limit
Temperature	± 0.2 °C
pH	± 0.2 Standard Units
Specific Conductance	± 5.0% of reading
Oxygen Reduction Potential	± 10.0% of reading
Dissolved Oxygen	≤20% Saturation
Turbidity	≤10 NTU

Notes:
°C = degrees Celsius
NTU = nephelometric turbidity units

If the criteria for dissolved oxygen and/or turbidity cannot be met, the range between the highest and the lowest values for the last three measurements cannot exceed the stated limits in Table 4.

Table 4
Default Criteria for Dissolved Oxygen and Turbidity
if Stabilization Criteria is Not Achieved

Parameter	Stability Limit
Temperature	± 0.2 °C
pH	± 0.2 Standard Units
Specific Conductance	± 5.0% of reading
Oxygen Reduction Potential	± 10.0% of reading
Dissolved Oxygen	± 0.2 mg/L or 10%, whichever is greater
Turbidity	± 5 NTUs or 10%, whichever is greater

Notes:
°C = degrees Celsius
mg/L = milligrams per liter
NTU = nephelometric turbidity units

If the stabilization parameters described cannot be met, and all attempts have been made to minimize the drawdown, check the instrument condition and calibration, purging flow rate and all tubing connections to determine if they might be affecting the ability to achieve stable measurements. All measurements that were made during the attempt must be documented, as well as a description pertaining to why the dissolved oxygen and/or turbidity were requirements were not achieved, and associated pertinent information. The sampling team leader may decide whether or not to collect a sample or to continue purging after three well volumes have been removed from the well.

5.6 Groundwater Sampling

Wells should be sampled immediately upon completion of purging operations. Once the water level stabilizes, the pumping rate should remain constant during low-flow sampling (generally less than 500 mL/min). For VOCs, lower sampling rates (100 to 200 mL/min) may be required.

- Record field parameters prior to sampling.
- Record depth to water levels prior to sampling (note if the well has not stabilized).
- Record the flow rate determined using a calibrated measuring device.
- Disconnect the flow-through cell and other equipment from the pump discharge tube.
- Collect samples from the pump discharge tube (or if using a peristaltic pump, by the method described in Section 5.3).
- Collect sample in the order cited in Section 5.8.

If, after three well volumes have been removed, the chemical parameters have not stabilized according to the criteria, the sampling team may elect to collect a sample. In most cases, after removing three well volumes of water, it may be assumed that fresh formation water is being collected by the pump intake. However, all site-specific data should be considered in determining whether sample collection is appropriate in a given situation. The conditions of sampling should be noted in the field log or field information form.

Low Yield Formations

In some situations, even with very slow purge rates, the well drawdown may not stabilize. In this case, sampling the water within the well screen zone provides the best opportunity to determine the formation water chemistry, as well purging can greatly affect sample chemistry through changes in dissolved gas levels, dissolved metals and VOCs.

Attempts should be made to avoid purging wells to dryness. This can usually be accomplished by slowing the purge rate. If the well is evacuated during the purging procedures listed, the sample may be collected as soon as a sufficient volume of water has recovered in the well. If the well goes dry repeatedly (i.e., over multiple monitoring events) prior to sampling, then a minimum purge or "passive" sampling approach should be used in lieu of well evacuation.

In the case of a fully dry purge (not recommended): This criterion applies only if purging was attempted as described, and if it is impossible to balance the pumping rate with the rate of recharge at very low pumping rates (less than 100 mL/min). If wells have previously and consistently purged dry and the current depth to groundwater indicates that the well will purge dry during the sampling, minimize the amount of water removed from the well before collecting the sample:

- Place the pump or tubing intake within the well screened interval.
- Use 1/4-inch OD diameter Teflon, polyethylene, or polypropylene tubing and the smallest possible pump chamber volume to minimize the total volume of water pumped from the well and to reduce drawdown.
- Select tubing that is thick enough to minimize oxygen transfer through the tubing walls while pumping.
- Pump at the lowest possible rate (100 mL/min or less) to reduce drawdown to a minimum.
- Purge at least two volumes of the pumping system (pump, tubing and flow-through cell, if used).
- Measure pH, specific conductance, temperature, ORP, DO and turbidity and begin to collect the samples.

<u>Collect samples immediately after purging is complete</u>. If adequate volume is available upon completion of purging, the well must be sampled immediately. If sample collection does not occur within one hour of purging completion, re-measure the field parameters just prior to collecting the sample. If the measured values are not within the stability criteria re-purge the well (the exception is for "dry" wells). If well must recover prior to sampling, sample the well as soon

as adequate volume has recovered. Sampling of wells which have a slow recovery should be scheduled so that they can be purged and sampled in the same day, after adequate volume has recovered. Wells of this type should not be purged at the end of one day and sampled the following day.

5.7 Groundwater Sampling Using Peristaltic Pump/Vacuum Jug Assembly

Some states and/or regions discourage organic sample collection through peristaltic pump flexible tubing used in the pump head. In these instances, when collecting samples for organic compound analyses it may be necessary to use a vacuum container, placed between the pump and the well for sample collection. Figure 1 shows the vacuum/jug assembly apparatus.

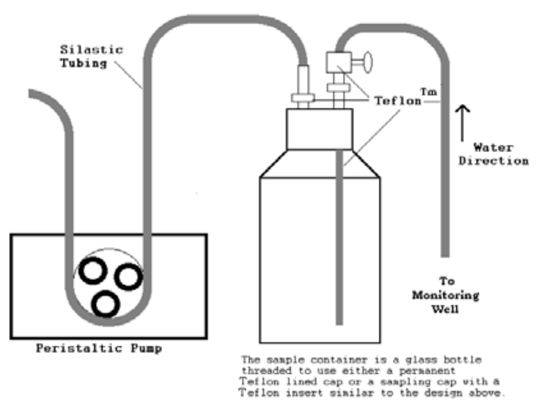


Figure 5-1
Vacuum Jug/Assembly Apparatus

The following step-by-step procedures, obtained from the U.S. Environmental Protection Agency (USEPA) Region 4 SOP, *Groundwater Sampling*, describe the process of sampling with a peristaltic pump and vacuum jug (see note following these procedures for collection of VOC samples):

1. Disconnect the purge tubing from the pump after low flow is established. Make sure the tubing is securely attached to the protective casing or other secure object.

2. Insert the tubing into one of the ferrule nut fittings of a Teflon vacuum container transfer cap assembly.

3. Place a suitable length of Teflon tubing between the remaining transfer cap assembly ferrule nut fitting and the vacuum side of the flexible tubing in the peristaltic pump head. Securely hand-tighten both fittings.

4. Turn the pump on. Water should begin to collect in the transfer container (typically a 1-liter sample container) within a few minutes. If water does not begin to flow into the container within several minutes, check the transfer cap fittings and make sure the assembly is tightly attached to the container. It may be necessary to tighten the ferrule nuts with a wrench or pliers to achieve a vacuum in the system, particularly when approaching the maximum head difference between the pump and water table (limit of suction).

5. When the transfer container is nearly full, turn off the pump, remove the transfer cap assembly, and pour the sample into the appropriate containers.

6. If additional sample volume is needed, replace the transfer cap assembly, turn the pump on, and collect additional volume. The use of Teflon valves or ball check devices to retain the water column in the sample delivery tubing during the transfer phase, when large volumes of sample are required, is acceptable. These devices, however, must be constructed so that they may be completely disassembled and cleaned.

NOTE: Samples for volatile organic compound analyses cannot be collected using this method. If samples for VOC analyses are required, they must be collected with a Teflon or stainless steel bailer or by other approved methods, such as the "soda straw" method. The "soda straw" method involves allowing the tubing to fill, by either (A) lowering it into the water column or (B) by filling it via suction applied by the pump head. If method (A) is used, the tubing is removed from the well after filling and the captured sample is allowed to drain into the sample vial. If method (B) is used, after running the pump and filling the tubing with sample, the pump speed is reduced and the direction reversed to push the sample out of the tubing into the vials. Avoid completely emptying the tubing when filling the sample vials when using method (B) to prevent introducing water that was in contact with the flexible pump head tubing. Either method is repeated, as necessary, until all vials are filled.

5.8 Sample Handling and Preservation

The laboratory will supply the necessary sample bottles and required preservatives. In some cases, the field team may add preservatives in the field. Improper sample handling may alter the analytical results of the sample. Therefore, transfer samples in the field from the sampling equipment directly into the laboratory provided containers as described above and in the project-specific planning documents.

It is not an acceptable practice for samples to be composited in a common container in the field and then split in the laboratory, or poured first into a wide mouth container and then transferred into smaller containers.

Collect groundwater samples and place them in their proper containers in the order of decreasing volatility and increasing stability. A preferred collection order for some common groundwater parameters is:

1. VOCs and total organic halogens
2. Dissolved gases, total organic carbon, total fuel hydrocarbons
3. Semi-volatile organics, pesticides
4. Total metals, general minerals (unfiltered)
5. Dissolved metals, general minerals (filtered)
6. Phenols
7. Cyanide
8. Sulfate and chloride
9. Turbidity
10. Nitrate and ammonia
11. Radionuclides

When sampling for VOCs, collect water samples in the laboratory pre-preserved vials by allowing the groundwater to slowly flow along the sides of the vial. Sampling equipment shall not touch the interior of the vial. Fill the vial above the top of the vial to form a positive meniscus with no overflow. No headspace shall be present in the sample container once the container has been capped. This can be checked by inverting the bottle once the sample is collected and tapping the side of the vial to dislodge air bubbles that may adhere to the sample cap or wall of sample vial. Sometimes it is not possible to collect a sample without air bubbles, particularly water that is aerated. In these cases, the investigator shall note the problem to account for possible error. Cooling samples may also produce headspace, but this will typically disappear once the sample is warmed prior to analysis. In addition, if the samples are shipped by air, air bubbles may form. Field logs should note any headspace in the sample container(s) at the time of collection.

Preserve samples immediately upon collection. Ideally, sampling containers will be pre-preserved with a known concentration and volume of preservative. For example, metals require storage in aqueous media at pH of 2 or less. Typically, 0.5 mL of 1:1 nitric acid added to 500 mL of groundwater will produce a pH less than 2. Certain matrices that have alkaline pH (greater than 7) may require more preservative. An early assessment of preservation techniques, such as the use of pH strips after initial preservation, may therefore be appropriate. The introduction of preservatives will dilute samples, and may require normalization of results. Calcium rich groundwater will react with the hydrochloric acid preservative and effervesce in VOC vials. In such instances, the laboratory should be contacted for possible removal of the preservative and reduction in the sample holding time. Guidance for the preservation of environmental samples can be found in the USEPA *Handbook for Sampling and Sample Preservation of Water and Wastewater* (USEPA 1982). Additional guidance can be found in other USEPA documents (USEPA 1992, 1996).

5.9 Quality Assurance/Quality Control Samples

The accuracy and precision of the field methods and laboratory analytical procedures are assessed through QA/QC samples collected during the sampling program. QA/QC samples may be labeled with QA/QC identification numbers or fictitious identification numbers if blind submittal is desired, and are sent to the laboratory with the other samples for analyses. The frequency, types, and locations of QA/QC samples should be specified in the SAP. Examples of QA samples include, but are not limited to, equipment rinsate blanks, field blanks, trip blanks, filter blanks, duplicate samples, and matrix spike (MS)/matrix spike duplicate (MSD) samples.

5.9.1 Equipment Rinsate Blanks

Equipment rinsate blanks are intended to check if decontamination procedures have been effective and to assess potential contamination resulting from containers, preservatives, sample handling and laboratory analysis. Procedures for collection are as follows:

1. Select a piece of sampling equipment that has been decontaminated onsite per the site-specific requirements.

2. Rinse the decontaminated sampling apparatus with deionized water. Allow the rinsate to drain from the sampling apparatus directly into the sample bottle or into a secondary container which is then poured into the sample bottle;

3. Specify on the chain-of-custody (COC) form the same analytical methods for rinsate samples as is specified for the groundwater samples;

4. Assign the rinsate sample an identification number and label as rinsate samples; and

5. Place the rinsate sample in a chilled cooler and ship it to the laboratory with the other samples.

5.9.2 Field Blanks

Field blanks are used to assess the contamination of samples during sample collection and are prepared at a sampling location by pouring decontamination source water into the sample bottle. The field blank sample should be analyzed by the same methods as the groundwater samples. An identification number/sample name shall be assigned and recorded in the logbook and the groundwater sample location where the field blank was prepared should also be recorded. The frequency of the field blank samples will be identified in the project SAP.

5.9.3 Trip Blanks

Trip blanks are volatile organic samples that are prepared in the laboratory using analyte-free water. Trip blanks are analyzed to assess VOC contamination of samples during transport and are used only when VOCs are suspected and being analyzed in the groundwater samples. One trip blank will be included for each cooler that contains samples for VOC analysis. At no time should the trip blanks be opened by field personnel.

5.9.4 Field Duplicate Samples

Field duplicate samples are collected to assess the precision of field and laboratory components of field samples. When collecting a duplicate groundwater sample, the original and duplicate sample containers should be filled simultaneously, or as close to simultaneous as possible, by moving the discharge tubing or bailer back and forth over each container until they are full.

The duplicate sample is handled and preserved in the same manner as the primary sample and assigned a sample number, stored in a chilled cooler, and shipped to the laboratory with the other samples. Whenever possible, the sample identification numbers for the investigation sample and its duplicate are independent such that the receiving laboratory is not able to distinguish which samples are duplicates prior to analysis. The frequency of the field duplicate samples will be identified in the project SAP.

5.9.5 Matrix Spike/Matrix Spike Duplicate Samples

An extra volume of sample media may be collected during the sampling event for performance of MS/MSD or MS/lab duplicate analyses by the laboratory to assess laboratory accuracy, precision, and matrix interference. Aqueous MS/MSDs are collected in triplicate volume using the same sample procedures as field duplicates. MS/MSDs must be identified using the same identification as the parent sample and must be identified on the COC form to inform the laboratory that the sample is intended to be used for spiking. Samples chosen for spiking should be representative of the matrix indicative of site conditions. MS/MSDs are collected, preserved, transported, and documented in the same manner as the samples. The frequency of the MS/MSD samples will be identified in the project SAP.

6.0 RECORDS

Document information collected during groundwater sampling in logbooks or on the groundwater sampling form provided in Attachment 1. Information to be recorded includes the following:

- Identification of well
- Well depth
- Static water level depth
- Purge volume and pumping rate
- Stable water level during sampling
- Time that the well was purged
- Sample name/identification numbers
- Well purging/sampling equipment
- Date and time of collection
- Field observations
- Name of personnel
- Weather conditions

Copies of the groundwater sampling forms should be maintained by the Field Team Leader through the duration of field sampling activities and provided to the CTO Manager at the completion of the groundwater sampling event. Groundwater sampling forms for each sampling event should be maintained with the permanent site records.

7.0 HEALTH AND SAFETY

Depending upon the site-specific contaminants, various protective programs must be implemented prior to sampling the first well. Review the site-specific health and safety plan (HASP) paying particular attention to the control measures planned for the well sampling tasks. Conduct preliminary area monitoring of wells to determine the potential hazard to sampling personnel. If significant contamination is observed, minimize contact with potential contaminants in both the vapor phase and liquid matrix through the use of respirators and disposable clothing.

Safety glasses with splash shields or goggles, disposable gloves, and steel-toe boots shall be worn during all groundwater sampling events, unless a higher level of personal protective equipment (PPE) is designated in the site-specific HASP.

Groundwater monitoring wells may be located in overgrown and/or wooded areas. Biological hazards such as poison ivy may be present. Such wells should be approached and opened with caution, in case insects or a snake have nested inside a well's protective casing.

Depending upon the type of contaminant expected or determined in previous sampling efforts, employ the following safe work practices:

- Avoid skin contact with and/or incidental ingestion of purge water.
- Wear long-sleeved protective gloves and splash protection (i.e., Saranex or splash suits and face shields) as warranted.
- Use eye protection and gloves when handling acid or caustic preservatives.
- Avoid breathing constituents venting from the well by approaching upwind, and/or by use of respiratory protection.
- If historical knowledge or evidence of free-phase is present, evaluate the well headspace with a flame or photo ionization detector prior to sampling.

- If monitoring results indicate organic vapors that exceed action levels as specified in the HASP, sampling activities may need to be conducted in Level C protection. The site safety officer and/or field manager should be notified and a determination made based on protocols in the HASP for proper PPE or to use other methods to mitigate potential exposure during sampling. At a minimum, use skin protection, such as Tyvek or other media that is protective against the encountered media.

8.0 REFERENCES

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9.0 ATTACHMENTS

Attachment 1 Groundwater Sampling Form

Attachment 1

Example Well Development and Groundwater Sampling Form

Attachment 1: Example Groundwater Sampling Form

DATE:	JOB NUMBER:	PHASE:	TASK:
PROJECT:	EVENT:		
WELL ID:	LOCATION:		
WEATHER CONDITIONS:	AMBIENT TEMP:		
REVIEWED BY:	PERSONNEL:		

WELL DIA:	WELL DEVELOPMENT	
TOTAL DEPTH from TOC (ft.):	START:	FINISH:
DEPTH TO WATER from TOC (ft.):	VOLUME PURGED (gal):	
LENGTH OF WATER COL. (ft.):	GROUNDWATER SAMPLING	
1 VOLUME OF WATER (gal):	START:	FINISH:
3 VOLUMES OF WATER (gal):	VOLUME PURGED (gal):	
	ANALYSIS:	

MNA FIELD RESULTS

FERROUS IRON	mg/L	CHLORIDE	mg/L		mg/L
SULFIDE	mg/L	ALKALINITY	mg/L		mg/L
SULFATE	mg/L	CO_2	mg/L		mg/L

IN-SITU TESTING

Circle one: DEVELOPMENT SAMPLING ☐ Bailer ☐ Pump Description:

Time (hh:mm):													
pH (units):													
Conductivity (mS/cm):													
Turbidity (NTU):													
DO (mg/L): Horiba													
YSI													
Temperature (C°):													
ORP (mV):													
Volume Purged (gal):													
Depth to Water (ft):													
Orion ORP: mV													
E_H													
Rel mV													
								Well Goes Dry While Purging ☐					

SAMPLE DATA ☐ Bailer ☐ Pump Description:

Sample ID	Date (m/d/y)	Time (hh:mm)	Bottles (total to lab)	Filtered (0.45 μm)	Remarks
Purging/Sampling Device Decon Process:					

COMMENTS:

Purge water placed in drum#_______________ Page __ of __

Standard Operating Procedure SOP-3-17

Water Quality Parameter Testing for Groundwater Sampling

1.0 PURPOSE

This standard operating procedure (SOP) represents minimum standard of practice. State and federal requirements may vary, and this SOP does not replace state and federal requirements that must be consulted before work begins. Further, if a project-specific work plan has been created, the work plan should be considered the ruling document. This SOP may be modified to meet specific regulatory, client, or project specific criteria.

If there are procedures whether it be from Resolution Consultants, state and/or federal that are not addressed in this SOP and are applicable to water quality parameter testing, then those procedures may be added as an appendix to the project-specific Sampling and Analysis Plan (SAP).

2.0 SCOPE

This procedure provides guidance for expected sampling methods and protocols by all personnel related to the measurement of water quality parameters.

Field measurements of water quality parameters are commonly performed to evaluate surface water and groundwater. These tests are often performed to evaluate basic water quality parameters, to evaluate natural attenuation parameters, and to assess the presence of pore water entering a well.

As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment during unforeseen circumstances. Deviations from this procedure while planning or executing planned activities must be approved by either the Contract Task Order (CTO) Manager or the Quality Assurance (QA) Manager, and documented.

3.0 DEFINITIONS

3.1 Barometric Pressure (BP)

The density of the atmosphere, which varies according to altitude and weather conditions.

3.2 Conductivity/Specific Conductance

A measure of the ability of water to pass electrical current, which increases with the amount of dissolved ionic substances (i.e., salts). Conductivity is inversely related to the resistance of a solution and is measured in units of mhos per centimeter (mhos/cm) (inverse ohms/cm, Siemens/cm). The conductivity of water increases with increasing temperature.

Specific Conductance is corrected for 25 degrees Celsius (°C); for this reason, it is best to record Specific Conductance. If Conductivity is recorded, the temperature of the sample MUST recorded.

3.3 Dissolved Oxygen (DO)

The amount of oxygen present in water and available for respiration. DO is typically measured in milligrams per liter (mg/L). Oxygen is less soluble in warm and salty waters, so the instrument compensates the apparent percent saturation for changes in temperature and conductivity. Most probes measure the current resulting from the electrochemical reduction of oxygen (at a gold cathode) diffusing through a selective membrane. Because oxygen is being removed from the sample to perform the measurement, sample flow is required to prevent false low readings due to depletion of oxygen in the solution in front of the probe. Optical DO probes do not remove oxygen from the sample and are less affected by salts. The common range of DO in groundwater is 0.0 to 3.0 mg/L. Measurements outside of this range suggest that the meter may not be operating correctly.

3.4 Nephelometric Turbidity Unit (NTU)

The measurement of light passing through a sample based on the scattering of light caused by suspended particles.

3.5 pH

A measure of acidity and alkalinity of a solution using a logarithmic scale on which a value of 7 represents neutrality, lower numbers indicate increasing acidity, and higher numbers are increasingly basic.

3.6 Oxidation-Reduction Potential (ORP)

Also known as redox or eH, ORP is a measurement of the potential for a reaction to occur, which generally indicates the oxygen status of a sample. The probe consists of a platinum electrode, the potential of which is measured with respect to a reference electrode that rapidly equilibrates with the potential of the sample solution. A positive value indicates that oxygen is present. A negative value indicates an anaerobic environment or reducing condition. For this reason, negative ORP readings should be associated with DO readings of less than 0.5 mg/l; with negative ORP readings the water may exhibit a sulfur odor or gray color. Positive ORP readings should be associated with DO readings greater than 0.5 mg/L and lack of sulfur odors. Because of the complex relationship between ORP and temperature, no compensation is attempted; it is thus best to report both the ORP and temperature of a water sample.

3.7 Total Dissolved Solids

A measure of the quantity of materials in water that are either dissolved or too small to be filtered.

3.8 Turbidity

Measure of the clarity of water in NTUs. Potable water typically has NTU values between 0.0 and 0.3 NTUs, depending on the state or regulatory program.

4.0 RESPONSIBILITIES

The CTO Manager, or designee, is responsible for ensuring that these standard groundwater sampling activities are followed and shall review all groundwater sampling forms at the conclusion of a sampling event. The CTO Manager is responsible for ensuring that all personnel involved in monitoring well sampling shall have the appropriate education, experience, and training to perform their assigned tasks. The QA Manager or Technical Director is responsible for ensuring overall compliance with this procedure. The Field Manager is responsible for ensuring that all project field staff follows these procedures.

Field sampling personnel are responsible for the implementation of this procedure. Personnel are required to be knowledgeable of the procedures in this SOP. Training and familiarization with this SOP shall be documented in the training file for each employee. The field sampler and/or Field Manager is responsible for directly supervising the calibration procedures to ensure that they are conducted according to this procedure, and for recording all pertinent data. If deviations from the procedure are required because of anomalous field conditions, they must first be approved by the CTO Manager, QA Manager, or Technical Director and then documented in the field logbook and associated report or equivalent document.

5.0 PROCEDURES

5.1 Purpose

The procedures will vary depending on parameters being measured, method of sampling, and the method of measurement used. The information here is a general guidance and the site-specific documents and manufacturer manuals supersede these procedures.

5.2 Cautions

Improper use of water quality testing equipment could result in equipment damage or compromised sampling results. Personnel should be trained to operate the test equipment being used for a field operation and should be trained in the proper techniques for collecting and logging water quality parameters. Personnel should also be able to recognize problems with test equipment and have someone available for basic troubleshooting and repair.

5.3 Interferences

During field testing, water quality data that is documented from field testing equipment may be influenced by certain outside factors that are unrelated to the actual site water quality. Such parameters and equipment include the following:

pH Meters

- Coatings of oils, greases, and particles may impair the electrode's response. Pat the electrode bulb dry with lint-free paper or cloth and rinse with de-ionized water. For cleaning hard-to-remove films, use isopropyl alcohol very sparingly so that the electronic surface is not damaged.

- Poorly buffered solutions with low specific conductance (less than 200 microsiemens per centimeter) may cause fluctuations in the pH readings. Equilibrate electrode by immersing in several aliquots of sample before taking pH.

Dissolved Oxygen

- Dissolved gases (e.g., hydrogen sulfide, halogens, sulfur dioxide) are a factor with the performance of DO probes. The effect is less pronounced on optical DO meters. Meter type and potential interferences should be considered based on potential sulfate/sulfide or nitrate/nitrite reducing environments.

- Exposure of the sample to the atmosphere will cause elevated DO measurements.

Turbidity Meter

- If the weather is warm and humidity is high, condensation may collect on the cuvet. To avoid this, allow the sample to warm and dry the outside of the cuvet before making the measurement. One method used to accomplish this is to place the cuvet against one's body (armpits work well).

Temperature

- Sample temperature will change rapidly when there are significant differences between the sample and ambient air.

5.4 Apparatus and Materials

Field personnel shall consult the site work plan and SAP to review the equipment requirements for the sampling procedures to be followed during the sampling effort. The specific apparatus and materials required will depend on the water quality parameters being monitored. Table 1 shows the common equipment used in water quality parameter testing.

Table 1
Water Quality Parameter Testing — Common Equipment

Water Quality Parameter Instrument	Calibration Standards Required	Other Equipment
pH Meter	Yes - 2 or 3 Point Standards depending on groundwater range. Calibration must cover the range to be measured. If samples are above or below typical buffer standards (4, 7 and 10), special order buffers that fall outside groundwater pH range.	Container or flow thru cell for holding sample
Specific Conductance	Yes	Container or flow thru cell for holding sample
ORP Meter	Yes	Container or flow thru cell for holding sample
Turbidity Meter	Yes	Container or flow thru cell for holding sample
DO	No	Container or flow thru cell for holding sample
Thermometer	No	Container or flow thru cell for holding sample
Flow Rate	No	Calibrated Container

Notes:
ORP = Oxidation-Reduction Potential
DO = Dissolved Oxygen

5.5 Instrument or Method Calibration

Most monitoring instruments require calibration before use, and this calibration must be conducted in the field under the ambient climatic conditions that will be present during field sampling. Calibration of monitoring instruments shall be performed in accordance with the manufacturer's specifications and recorded in the provided form in Attachment 1. Site-specific instrument calibration requirements should be specified in the SAP. The following minimum calibration requirements apply to the various types of meters used to gather water quality measurements.

Initial Calibration (IC): Before use, the instrument or meter electronics are adjusted (manually or automatically) to a theoretical value (e.g., DO saturation) or a known value of a calibration standard. An IC is performed in preparation for the first use of an instrument or if a calibration verification does not meet acceptance criteria.

Initial Calibration Verification (ICV): The instrument or meter calibration is checked or verified directly following IC by measuring a calibration standard of known value as if it were a sample and comparing the measured result to the calibration acceptance criteria for the instrument/parameter. If an ICV fails to meet acceptance criteria, immediately recalibrate the instrument using the applicable initial calibration procedure or remove it from service.

Continuing Calibration Verification (CCV): After use, the instrument or meter calibration is checked or verified by measuring a calibration standard of known value as if it were a sample and comparing the measured result to the calibration acceptance criteria for the instrument/parameter.

5.5.1 Calibration Checks

Calibration checks are conducted by measuring a known standard. They must be completed after calibration and should be performed at least one other time (i.e., after lunch) and anytime suspect measurements are encountered. Table 2 provides general acceptance ranges to be used during calibration checks. If a meter is found to be outside of the acceptance range, the meter **must** be recalibrated. If the meter remains out of range, the project manager and/or the supplier of the meter should be contacted to determine alternative measures.

Table 2
Calibration Check Acceptance Limits

Parameter	Acceptance Criteria
Dissolved Oxygen	±0.3 mg/L of the theoretical oxygen solubility
Oxidation-Reduction Potential	±10 mv from the theoretical standard value at that temperature
pH	±0.2 Standard pH Units
Specific Conductance	±5% of the standard
Turbidity	0.1 to 10 NTU: ±10% of the standard 11 to 40 NTU: ±8% of the standard 41 to 100 NTU: ±6.5% of the standard

Notes:
mg/L = milligrams per liter
mv = millivolts
NTU = nephelometric turbidity units

5.5.2 Possible and Suspected Ranges

The concentration for each parameter range should be known so that concentrations outside of the range can be noted. Table 3 presents the maximum range of the parameter in groundwater. The table also presents the suspected range. Measurements outside of the maximum/minimum range should be considered in error and the measurement method should be checked. Concentrations outside the normal range should be treated as suspect but may be the result of contaminant impact. For example, a pH of 2.0 would be out of the normally suspected range for groundwater but not at a site impacted with an acid.

Table 3
Minimum and Maximum Result Ranges

Parameter	Units	Possible Min	Possible Max	Normal Min	Normal Max	Notes
Dissolved Oxygen	mg/L	0.0	14.6 (0°C) 10.1 (15°C) 8.3 (2°C)	0.0	5	The colder the sample, the higher the DO reading. DO greater than 1 mg/L, ORP positive should not have sulfur odor, sulfide, ferrous iron and/or gray color. DO less than 1 mg/L, ORP negative, may have sulfur odor, sulfide, ferrous iron and/or gray color.
pH	SU	0	14	5	9	pH values exceeding 10 could indicate grout contamination
ORP	mv					DO greater than 1 mg/L, ORP positive should not have sulfur odor, sulfide, ferrous iron and/or gray color. DO less than 1 mg/L, ORP negative, may have sulfur odor, sulfide, ferrous iron and/or gray color.
Specific Conductance	µS/cm			varies	varies	
Temperature	°C	0	100	5	30	
Turbidity	NTU	0	Greater than 1,000	0	Greater than 1,000	50 NTU or greater suggests cloudiness.

Notes:
mg/L = milligrams per liter
°C = degrees Celsius
DO = dissolved oxygen
SU = standard units
ORP = oxidation reduction potential
mv = millivolts
mS/cm = micro Siemens per cm
NTU = nephelometric turbidity units

5.5.3 Field Instruments and Calibration Criteria

The calibration acceptance criteria for each instrument are summarized in Table 4 along with special considerations related to each field instrument.

Table 4
Calibration Check Acceptance Limits

Parameter	Acceptance Criteria
Dissolved Oxygen	±0.3 mg/L of the theoretical oxygen solubility.
Oxidation-Reduction Potential	±10 mv from the theoretical standard value at that temperature.
pH	±0.2 Standard pH Units
Specific Conductance	±5% of the standard
Turbidity	0.1 to 10 NTU: ±10% of the standard 11 to 40 NTU: ±8% of the standard 41 to 100 NTU: ±6.5% of the standard

Notes:
mg/L = milligrams per liter
mv = millivolts
NTU = nephelometric turbidity units

pH Meters

- For the most accurate of pH measurements, pH meters should receive a three-point calibration. However, if a two-point calibration will bracket the groundwater pH of the site, a two-point calibration is acceptable. Three-point calibrations typically include calibrating to solutions of pH 7.00, 4.00, and 10.00. If groundwater pH is outside the calibration range of the solution standards, special buffers must be ordered to bracket the pH. Some meters will report the slope of the calibration and this may be used in checking the meter calibration (refer to the meter's manual). When performing an ICV, the result must be within +/- 0.2 pH units of the stated buffer value.

- pH meters should be calibrated across the range of values to be measured. The maximum and minimum calibration solutions shall be outside the range of anticipated values. For example, if the expected range is between 7.50 and 9.00, the 7.00 and the 10.00 standard should be used for calibration. Perform the IC using at least two buffers, and always use the pH 7.00 buffer first. A reading that is above the maximum (or below the minimum) calibration standard is an estimate only and is not valid. This condition requires obtaining a new standard that is above (or below) the reported value, depending on the measurement.

- A percent slope of less than 90 percent indicates a bad electrode that must be changed or repaired. If percent slope cannot be determined, or the manufacturer's optimum specifications are different, follow the manufacturer's recommendation for maintaining optimum meter performance.

Specific Conductivity Meters

- For IC, when the sample measurements are expected to be 100 microsiemens per centimeter (µS/cm) or greater, use two standard potassium chloride (KCl) solutions that bracket the range of expected sample conductivities. Calibrate the instrument with the first standard. Verify the calibration of the instrument with the second standard, bracketing the range of expected sample values.

- If the instrument can be calibrated with more than one standard, choose additional calibration standards within the range of expected sample values.

- When the sample measurements are expected to be less than 100 µS/cm, a lower bracket is not required, but one standard (KCl) solution that is within the range of expected measurements must be used for the IC and the ICV.

- Accept the calibration if the meter reads within +/- 5 percent of the value of any calibration standard used to verify the calibration.

- Most field instruments read conductivity directly. Record all readings and calculations in the calibration records.

- For CCV, check the meter with at least one KCl standard with a specific conductance in the range of conductivity measured in environmental samples. The reading for the calibration verification must also be within +/- 5 percent of the standard value.

- If new environmental samples are encountered outside the range of the IC, verify the instrument calibration with two standards bracketing the range of sample values. If these calibration verifications fail, recalibrate the instrument.

Dissolved Oxygen Meters

- Before calibrating, check the probe membrane for bubbles, tears, or wrinkles. These conditions require replacement of the membrane in accordance with the manufacturer's directions.

- If the meter provides readings that are off-scale, will not calibrate, or drift, check the leads, contacts, etc., for corrosion and/or short circuits. These conditions require replacement maintenance in accordance with the manufacturer's directions.
- Most DO meters must be calibrated based on an environment of 100 percent humidity and a known elevation and barometric pressure (BP).

- For 100 percent humidity, place the probe in the calibration container with a moist towel and allow the probe to remain, undisturbed, for 10 to 20 minutes.

- The IC is an air calibration at 100% saturation. Before use, verify the meter calibration in water-saturated air to make sure it is properly calibrated and operating correctly. Make a similar verification at the end of the day or sampling event. Follow the manufacturer's instructions for your specific instrument. Allow an appropriate warm up period before IC. Wet the inside of the calibration chamber with water, pour out the excess water (leave a few drops), wipe any droplets off the membrane/sensor and insert the sensor into the chamber (this ensures 100 percent humidity). Allow adequate time for the DO sensor and the air inside the calibration chamber to equilibrate. Once the probe/calibration chamber is stable at ambient temperature, check the air temperature and determine, from the DO versus temperature table (see Attachment 2) what DO should measure. The acceptance criterion for DO ICV is +/- 0.3 mg/L.

- Use the same procedure as above for CCV.

ORP Meters

- Verify electrode response before use in the field.

- Equilibrate the standard solution to the temperature of the sample. The standard solution is based on a 25°C temperature; however, the calibration solution standard's value will require adjustment based on the temperature.

- Immerse the electrodes and gently stir the standard solution in a beaker (or flow cell). Turn the meter on, placing the function switch in the millivolt (mv) mode.

- Let the electrode equilibrate and record the reading to the nearest millivolt. The reading must be within ±10 mv from the theoretical redox standard value at that temperature. If not, determine the problem and correct it before proceeding. Switch to temperature display and read the value.

- Record the mv reading and temperature in the field notebook or in form. Rinse the electrode with distilled water and proceed with the sample measurement, unless using a flow cell. If a flow cell is used, rinse between sample locations.

Turbidity Meters

- Perform an initial calibration using at least two primary standards.

- If the instrument cannot be calibrated with two standards, calibrate the instrument with one standard and verify with a second standard.

- Perform an ICV by reading at least one primary standard as a sample. The acceptance criterion for the ICV depends on the range of turbidity of the standard value:

    1. Standard Value = 0.1 to 10 NTU: the response must be within 10 percent of the standard;

    2. Standard Value = 11 to 40 NTU: the response must be within 8 percent of the standard;

    3. Standard Value = 41 to 100 NTU: the response must be within 6.5 percent of the standard; and

    4. Standard Value greater than 100 NTU: the response must be within 5 percent of the standard.

- Determining the Values of Secondary Standards: Use only those certified by the manufacturer for a specific instrument. Secondary standards may be used for CCVs.

To initially determine the value of a secondary standard, assign the value that is determined immediately after an ICV or verification with primary standards. This is done by reading the secondary standard as a sample. This result must be within the manufacturer's stated tolerance range and +/- 10 percent of the assigned standard value. If the +/- 10 percent criterion is not met, assign this reading as the value of the standard. If the reading is outside the manufacturer's stated tolerance range, discard the secondary standard.

- CCV: Perform a CCV using at least one primary or secondary standard. The calibration acceptance criteria are the same as those for an ICV.

5.6 Direct Measurements

Direct measurements with meters are the most common methods and can be accomplished by placing a sample in a container with the probe or by allowing the water to flow past the probe in a flow cell. The use of a flow-through cell improves measurement quality by allowing the constant flow of water over the probes and reduces interaction of the sample with the atmosphere. Sample cups should be avoided. The quantity of samples, timing, and methodology should be described in the project SAP.

Following calibration of required probes, connect the bottom flow-cell port to the discharge line of the pump. Connect the top port to a discharge line directed to a bucket to collect the purge water. Allow the flow cell to completely fill. As the water flows over the probe, record the measurements. Continue to record the measurements at regular intervals, as specified in the SAP.

When the ambient air temperatures are much higher or lower than the temperature of the water sample, it is best to keep the length of tubing between the wellhead and the flow cell as short as possible to prevent heating or cooling of the water. Tubing and flow-through cell should not be exposed to direct sunlight, particularly in the summer, if at all possible, to avoid heating of water samples.

5.7 Data Acquisitions, Calculations, and Data Reduction

5.7.1 Specific Conductivity Correction Factions

If the meter does not automatically correct for temperature (i.e., read Specific Conductivity) record Conductivity and adjust for temperature upon returning to the office. The following equation can be used to convert Conductivity to Specific Conductivity.

$$K = \frac{(Km)(C))}{1 + 0.0191(\mathrm{T} - 25)}$$

Where:

K	=	Conductivity in μmhos/cm at 25°C
Km	=	Measured conductivity in μmhos/cm at T degrees Celsius
C	=	Cell constant
T	=	Measured temperature of the sample in degrees Celsius;

If the cell constant is 1, the formula for determining conductivity becomes:

$$K = \frac{(Km)}{1 + 0.0191(\mathrm{T} - 25)}$$

5.7.2 Percentage Difference Calculation

For evaluating slope of readings from either a flow cell or a sample cup.

$$\%Difference = \frac{(Highest\ Value - Lowest\ Value)}{(Highest\ Value)}\ x\ 100$$

5.7.3 Convert mm mercury (mmHG) to inches mercury (inHG)

$$mmHG = inHG\ x\ 25.4$$

5.7.4 True Barometric Pressure

For converting BP obtained from a public domain source that is expressed in BP at sea level to BP at the subject site.

$$TrueBP = (BP) - \frac{(2.5\ x\ [Local\ Altitude])}{100}$$

Where: BP is in mmHG and Local Altitude is in feet

Example: BP at site A is 30.49 inHg and elevation is 544 feet, calculate TrueBP

Convert inHG to mmgHG:

mmHg = 30.49 inHg x 25.4 = 774.4 mmHg

Calculate True BP:

TrueBP = (774.4 mmHg) – [2.5 * (544 /100)] = 774.4-13.6 = 760.8 mmHg

6.0 RECORDS

Data will be recorded promptly, legibly, and in indelible ink on the appropriate logbooks and forms. At the completion of a field effort, all logbooks, field data forms, and calibration logs shall be scanned and made electronically available to the project team. The original field forms, calibrations logs, and log book will be maintained in the project file.

7.0 HEALTH AND SAFETY

Detailed Health and Safety requirements can be found in the site specific Health and Safety Plan. Ensure that a Safe Work Assessment and Permit form is filled out daily prior to any work in the field and reviewed with all project personnel in a daily safety brief.

Safety glasses with side shields or goggles and disposable gloves shall be worn during calibration activities.

8.0 REFERENCES

None

9.0 ATTACHMENTS

Attachment 1: Example Field Instrument Calibration Form
Attachment 2: Solubility of Oxygen at Given Temperatures
Attachment 3: Example Field Data Form

Attachment 1

Example Field Instrument Calibration Form

Field Instrument Calibration Form

Calibrated by: ______________________

Date: ______________________

Equipment (Make/Model/Serial#): ______________________

Equipment (Make/Model/Serial#): ______________________

pH (su) — Standard: ± 0.2 standard units

Initial Calibration / Initial Calibration Verification

	Hach SL	Reading	Pine SL	Reading
pH7				
pH4				

Continuing Calibration Verification

	Hach SL	Reading	Deviation	Acceptable Variance (Y/N)
pH7				
pH4				

DO (mg/L) — Standard: ± 0.3 mg/L of theoretical*

IC (Temp:) / ICV (Temp:)

Saturation (%)	Reading (%)	Theoretical (mg/L)	Reading (mg/L)
100			

CCV (Temp:)

Saturation (%)	Reading (%)	Deviation	Acceptable Variance (Y/N)
100			

Theoretical (mg/L)	Reading (mg/L)	Deviation	Acceptable Variance (Y/N)

ORP (mV) — Standard: NA

IC (Zobell SL:) / ICV (Pine SL:)

TCS (Std/Temp)	Reading	TCS (Std/Temp)	Reading

CCV (Zobell SL:)

TCS (Std/Temp)	Reading	Deviation	Acceptable Variance (Y/N)

Turbidity (ntu) — Standard: ±10% of Standard

Initial Calibration

Standard	Reading

Continuing Calibration Verification

Standard	Reading	Deviation	Acceptable Variance (Y/N)

Conductivity (ms^c/cm) — Standard: ± 5% of standard value

IC (YSI SL:) / ICV (Pine SL:)

Standard	Reading	Standard	Reading

CCV (YSI SL:)

Standard	Reading	Deviation	Acceptable Variance (Y/N)

Comments:

Notes:

SL	solution lot	su	standard units
TCS	temperature corrected standard	mV	millivolts
Std	standard	%	percent
Temp	temperature	mg/L	milligrams per liter
ntu	Nephelometric Turbidity Units	°C	degrees Celsius
ms^c/cm	millisiemens per centimeter (temperature corrected)	*	Theoretical value

Attachment 2

Solubility of Oxygen at Given Temperatures

Field Measurement of Dissolved Oxygen

Solubility of Oxygen in Water at Atmospheric Pressure			
Temperature	**Oxygen Solubility**	**Temperature**	**Oxygen Solubility**
°C	**mg/L**	**°C**	**mg/L**
0.0	14.621	26.0	8.113
1.0	14.216	27.0	7.968
2.0	13.829	28.0	7.827
3.0	13.460	29.0	7.691
4.0	13.107	30.0	7.559
5.0	12.770	31.0	7.430
6.0	12.447	32.0	7.305
7.0	12.139	33.0	7.183
8.0	11.843	34.0	7.065
9.0	11.559	35.0	6.950
10.0	11.288	36.0	6.837
11.0	11.027	37.0	6.727
12.0	10.777	38.0	6.620
13.0	10.537	39.0	6.515
14.0	10.306	40.0	6.412
15.0	10.084	41.0	6.312
16.0	9.870	42.0	6.213
17.0	9.665	43.0	6.116
18.0	9.467	44.0	6.021
19.0	9.276	45.0	5.927
20.0	9.092	46.0	5.835
21.0	8.915	47.0	5.744
22.0	8.743	48.0	5.654
23.0	8.578	49.0	5.565
24.0	8.418	50.0	5.477
25.0	8.263		

Notes:

The table provides three decimals to aid interpolation

Under equilibrium conditions, the partial pressure of oxygen in air-saturated water is equal to that of the oxygen in water saturated

°C = degrees Celsius

mg/L = milligrams per liter

Attachment 3

Example Field Data Form

WELL DEVELOPMENT & GROUNDWATER SAMPLING FORM

DATE:	JOB NUMBER:	EQUIPMENT (Make/Model #/Serial #):
PROJECT:	EVENT:	/ /
WELL ID:	LOCATION:	/ /
WEATHER CONDITIONS:	AMBIENT TEMP:	/ /
REVIEWED BY:	PERSONNEL:	/ /

WELL DIA:	WELL DEVELOPMENT	
TOTAL DEPTH from TOC (ft.):	START:	FINISH:
DEPTH TO WATER from TOC (ft.):	VOLUME PURGED (gal):	
LENGTH OF WATER COL. (ft.):	GROUNDWATER SAMPLING	
1 VOLUME OF WATER (gal):	START:	FINISH:
3 VOLUMES OF WATER (gal):	VOLUME PURGED (gal):	
	ANALYSIS:	

WELL DEVELOPMENT PARAMETERS		GW SAMPLING PARAMETERS	
Temperature:	± 1.0° C	Temperature:	± 0.2° C
pH:	± 0.5 standard units	pH:	± 0.2 standard units
Specific Conductance:	± 10% of the past measurement	Specific Conductance:	± 5% of the past measurement
Turbidity:	relatively stable	DO:	≤ 20% saturation
		ORP:	± 10 millivolts
		Turbidity:	≤ 10 NTU

IN-SITU TESTING

Circle one: DEVELOPMENT SAMPLING ☐ Bailer ☐ Pump Description:

Time (hh:mm):												
pH (units):												
Conductivity (mS/cm):												
Turbidity (NTU):												
DO (mg/L): YSI 556												
DO (mg/L): YSI 550												
Temperature (C°):												
ORP (mV):												
Volume Purged (gal):												
Depth to Water (ft):												
							Well Goes Dry While Purging ☐					

SAMPLE DATA

☐ Bailer ☐ Pump Description:

Sample ID	Date (m/d/y)	Time (hh:mm)	Bottles (total to lab)	Filtered (0.45 µm)	Remarks
Purging/Sampling Device Decon Process:					

COMMENTS:

Purge water placed in drum#____________

Standard Operating Procedures SOP-3-18 (MS)
Direct Push Sampling Techniques

1.0 PURPOSE

This standard operating procedure provides procedures for use of direct push sampling methods for collecting soil and groundwater samples. If there are additional procedures required by state and/or federal that are not addressed in this Standard Operating Procedure (SOP) and are applicable to direct push sampling then those procedures may be added as an appendix to the project specific Sampling and Analysis Plan.

2.0 SCOPE

This procedure shall serve as management-approved professional guidance and is consistent with protocol in the Uniform Federal Policy-Quality Assurance Project Plan (DoD 2005). As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment during unforeseen circumstances. Deviations from this procedure while planning or executing planned activities must be approved by either the Contract Task Order (CTO) Manager or the Quality Assurance (QA) Manager, and documented.

The physical nature of the subsurface materials, water depth, regulatory buy in, data quality objectives, and other issues will play an important part in deciding whether direct push methods are suitable for the project and should be discussed in the project-specific planning documents. Before field implementation of direct push methods, the following aspects will need to be considered:

- Permits required by local/state water Board/Districts, etc.
- Waste generation and handling
- Health and safety issues associated with chemical and physical hazards
- Locating subsurface and overhead utilities before field activities and adjust locations as necessary to account for impediments and obstacles.

If direct push methods are used for constructing small diameter monitoring wells, the following aspects should also be considered:

- Well locations and depths
- Permanent or temporary wells
- Screen length(s)
- Well completion specifications.

3.0 RESPONSIBILITIES

The CTO Manager is responsible for ensuring that the described direct push methods are followed and that all field personnel involved shall have the appropriate education, experience, and training to perform their assigned tasks as specified in Chief of Naval Operations Instruction 5090.1c (DON 2007).

QA Manager or Technical Director is responsible for ensuring overall compliance with this procedure.

The Field Manager is responsible for implementing or ensuring that all project field staff follow these procedures.

4.0 BACKGROUND

4.1 Direct Push Techniques

Direct push techniques (DPT) rely on use of hydraulically powered machines that utilize static and percussion forces to advance various tools in the subsurface for a variety of uses including soil and groundwater sampling, logging, grouting and materials injections. The machines are very portable and their small size makes them ideal for working inside buildings and confined areas. They are also very fast and generate very little investigative derived waste resulting in direct push methods being a very cost-effective sampling approach compared to traditional drilling methods. A variety of systems are available under several trade names, such as Geoprobe and Strataprobe. Equipment may be skid-mounted, trailered, or mounted directly on the frame of a vehicle. Major limitations of direct push techniques are their inability to penetrate rock or cobbles and a shallow maximum depth of penetration. The capabilities of direct push systems vary significantly among vendors. Consider these differences in capabilities when evaluating the method for a subsurface exploration program.

5.0 PROCEDURES

5.1 Soil Sampling

Vendors of direct push equipment offer a variety of sampling systems designed specifically for their equipment. Both continuous and discreet soil samples may be obtained using direct push sampling equipment and there are generally two methods for soil sampling, using either an open-tube sampler or closed-point sampler. The open tube sampler enables the continuous collection of soil cores from the ground surface to a depth dependent on the core hole staying open. Upon retrieving the sampler, the plastic liner and soil core are removed, the sampler properly decontaminated, reassembled with a new liner and inserted back down the same hole to collect the next soil core. The plastic liners are split lengthwise and the soil core within is described, screened and/or sampled as specified in the project-specific planning documents. Since a new liner is used with each sampler, the potential cross-contamination risk is minimized, resulting in an inherently safe soil sampling method.

Sandy soils or material collapsing from the probe side wall can make it difficult to collect representative soil cores from significant depths with an open tube sampler. A closed-point sampler (or piston sampler) seals the leading end of the sampler with a point assembly that is held in place with a center rod. Once the sampler is advanced to the top of the sampling interval, the probe rod string is removed which disengages the piston point, allowing soil to enter the sampler. The sampler is retrieved, the plastic liner and soil core are removed and the process is repeated until reaching the desired completion depth.

5.2 Groundwater Sampling

Groundwater samples and can be collected in-situ using a groundwater sampling device or through constructing small diameter (< 1.5 inch) monitoring wells, either permanent or temporary.

In-situ Groundwater Sampling

1. Place a drive cap on the assembled direct push sampler and drive it into the subsurface.

2. Continue driving by adding probe rods until the sampler tip has been driven about one foot below the target sampling depth.

3. After reaching the groundwater depth, disengage the expendable drive point by pulling the rods back a distance of about 2 feet and remove the drive cap.

4. Lower the sensor of an electric water level indicator until the audio signal sounds and record the depth to groundwater. The measurement tape scale (0.01 ft intervals) on the water level indicator wire is read at the top of the probe rod after pulling the tape out and extending it to the ground surface.

5. After recording the water level depth measurement, the indicator sensor is removed from the probe rods.

6. Lower a 0.25 to 0.375-inch OD polyethylene or Teflon tube inside the probe rods and evacuate groundwater with a peristaltic pump. When lowering tubing inside the rod string, ensure that it enters the screen interval. The leading end of the tubing will sometimes catch at the screen head giving the illusion that the bottom of the screen has been reached. An up-and-down motion combined with rotation helps move the tubing past the lip and into the screen.

7. Retrieve the sampler, clean all parts thoroughly, replace the O-rings, and prepare for the next sample.

Typically less than a gallon of water is purged until turbidity levels are stable and sampling follows. Since in-situ groundwater samples are usually collected as "screening" data and are a means to focus permanent monitoring wells, water quality parameters (pH, conductivity, turbidity, temperature) are not normally collected; however, field personnel should defer to the requirements of the project-specific planning documents. If sampling for volatile organic compounds (VOCs), the sample should not be circulated through the peristaltic pump since low level VOCs may be stripped from the sample, causing low bias in analyses. The methods described in SOP 7, *Monitoring Well Sampling* for sampling with a peristaltic pump should be adhered to.

In cases where the water depth is greater than 28 feet and the water cannot be lifted, groundwater samples may also be collected by attaching a check valve (with check ball) to the bottom end of the tubing and oscillating the tubing up and down until water exits the top of the tube.

Monitoring Well Installations with Direct Push Methods

1. Place a drive cap on the first section of 2.125-in. probe rod with an expendable drive point installed and advance the rod into the ground.

2. Continue driving by adding probe rods, with O-ring seals between each rod, until the sampler tip reaches approximately one foot below the screen installation depth.

3. After reaching the installation depth, the PVC well screen is lowered into the probe rods while adding threaded lengths of PVC riser pipe as needed. Care must be taken to tighten the threaded sections to prevent leakage at the joints. New, clean, rubber gloves are worn while handling all well screen and riser pipe materials to provide the highest quality samples from the well after installation.

4. After the screen and riser are set at the installation depth, the probe rods are retracted slightly while holding down pressure on the riser pipe. This disengages the expendable point from the bottom section of drive rod.

5. After disengaging the drive point, the screen is exposed to the aquifer. Before proceeding with the well installation, it is prudent to measure the static water level in the well. This allows for adjustment of the proper screen depth if required.

6. After assuring the proper installation depth, if pre-packed screens are not used, filter-pack sand is slowly poured within the annular space between the well screen and probe rods.

7. Filter sand is added, while retracting the probe rods, until the sand reaches approximately two feet above the screen length.

8. If the native formation is well-sorted sand, coarse enough to filter and not pass through the well screen filter sand may be unnecessary. Retracting the probe rods to approximately two feet above the top of the screen will allow collapse of the native formation around the screen.

9. Above the filter pack, a minimum two-foot thick bentonite seal is installed to prevent any infiltration from above reaching the sand pack and/or well screen. The bentonite seal is tremied from the bottom (top of the filter pack), with the high-pressure grout pump while retracting the probe rods.

10. A bentonite slurry can be used to grout the entire well annulus, or alternatively above the required minimum two-foot thick bentonite seal, the annulus can be grouted with neat cement.

11. Following 24 hours, the development and sampling of the well can proceed as for typical larger diameter wells.

Small-diameter (3/4 — 1 inch) monitoring wells can be installed using direct push methods and are commonly considered permanent, depending upon local and State regulations. The limitations and abilities of wells constructed should be thoroughly understood and before using direct push methods, it should be confirmed that:

1. The method effectively protects the well screen from exposure to contaminated overburden soils during installation

2. Effective filter packing is placed around the well screen (commercially available pre-packed well screens ensure adequate filter packing around well screen).

3. The well screen to be effectively sealed against the downward infiltration of overlying groundwater or surface precipitation

4. Well materials are compatible with the intended sampling and analysis goals of the project

5. The well screen is properly sized and slotted for the needs of the project

The project-specific planning documents should evaluate the appropriateness of direct push systems and whether collected data will meet the project objectives. As part of this evaluation, regulatory concurrence/approval should also be sought.

5.3 Equipment Decontamination

To avoid cross-contamination, thoroughly decontaminate equipment used for direct push exploration and sampling. Decontaminate sampling tools and downhole equipment between each sampling event and between penetration points. At a minimum, steam clean or wash and rinse the equipment with a combination of soapy water and a double rinse of clean water. The inside of the of the sample roads is cleaned with nylon brushes and extension rods. Use clean water and phosphate-free soap, cycle the brush inside the probe rod or sample tube to remove contaminants. Rinse with clean water and allow to air dry.

5.4 Borehole Abandonment

Some direct push boreholes will close naturally as the drive rods and sampling tools are withdrawn. This may occur in loose, unconsolidated soils, such as sands. Close all boreholes using one of the procedures described in this procedure, unless natural caving precludes such closure.

The three methods for closing direct push boreholes are:

1. Add granulated or pelletized bentonite and hydrate in layers, proceeding from the bottom of the hole to the surface.

2. Pour premixed cement/water (or cement/water/bentonite) mixture into the hole.

3. Fill the entire hole with granular or pelletized bentonite and hydrate by means of a previously emplaced water tube that is gradually withdrawn as water is supplied to the bentonite.

For shallow holes less than 10 feet in depth, pour a cement/water/bentonite mix directly into the opening using a funnel. For deeper holes, use a conductor (tremie) pipe to carry the grout mix to the far reaches of the borehole. Lower the conductor pipe to within 2 inches of the bottom and gradually withdraw it as grout is added, keeping the lower end of the pipe submerged in grout at all times. Seal boreholes to within 0.5 to 2.0 feet of the surface. Inspect the abandoned borehole after 24 hours to ensure that grout shrinkage does not occur. If significant shrinkage has occurred, re-grout the borehole. Fill the remaining portion of the hole with local topsoil or appropriate paving materials.

6.0 RECORDS

Record all DPT field activities in the appropriate field log book. Depending on the project objectives, soil classification may or may not be required. If it is required, complete a soil boring log as provided in Attachment 1. Monitoring wells constructed with direct push methods require both a well construction log and groundwater sampling log which are also provided in Attachments 2 and 3. Field personnel should provide copies of all completed forms to the Field Team Leader who is responsible for forwarding the forms to the CTO Manager who will review them for completeness before incorporating them into the project files.

7.0 HEALTH AND SAFETY

The primary hazards associated with direct push sampling are the mechanical hazards associated with machinery. Only qualified personnel should operate the equipment and field personnel should always maintain a safe distance from it. The minimum personal protective equipment (PPE) is safety glasses, hearing protection, steel-toed boots, and a hard hat. Depending upon the site-specific contaminants, additional PPE requirements may be required as designated in the site-specific HASP.

Employ the following safe work practices:

- Avoid skin contact with and/or incidental ingestion of purge water.
- Position DPT machine downwind of bore
- Use eye protection and gloves when handling acid or caustic preservatives.
- Avoid breathing constituents venting from the borehole by positioning rig upwind between field personnel/operators and the borehole.
- If historical knowledge or evidence of free-phase is present, use a flame or photo ionization detector to ensure the breathing zone is safe.
- If monitoring results indicate organic vapors that exceed action levels as specified in the HSP, be prepared to upgrade PPE to Level C protection.

8.0 REFERENCES

Department of Defense, United States (DoD). 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/-ufp_qapp_v1_0305.pdf.

9.0 ATTACHMENTS

Attachment 1 Soil Boring Log

Attachment 2 Well Construction Form

Attachment 3 Groundwater Sampling Form

Attachment 4 Geoprobe Screen Point 22 Groundwater Sampler

Attachment 1

Soil Boring Log

ENSAFE

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION

DRILLING METHOD:	BORING NO.
	SHEET OF
SAMPLING METHOD:	DRILLING

					START	FINISH
WATER LEVEL					TIME	TIME
TIME						
DATE					DATE	DATE
CASING DEPTH						

DATUM ELEVATION

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT SAMPLER	VAPOR CONCENTRATIONS (PPM)	DEPTH IN FEET	SOIL GRAPH	SURFACE CONDITIONS:
						0		
						1		
						2		
						3		
						4		
						5		
						6		
						7		
						8		
						9		
						0		
						1		
						2		
						3		
						4		
						5		
						6		
						7		
						8		
						9		
						0		

DRILLING CONTR. ____

BY ____ CHK'D BY ____ DATE ____

Attachment 2

Well Construction Form

Well Construction Form

Facility/Project Name:

Well ID.:

Facility License Number:

Type of Well:
Ground Water Monitoring ☐
Piezometer ☐ Injection ☐
Other__________________

Date Well Installed:

Location of well relative to waste source:
Upgradient ☐ Downgradient ☐ Side-gradient ☐ Unknown ☐

Well Installed By:

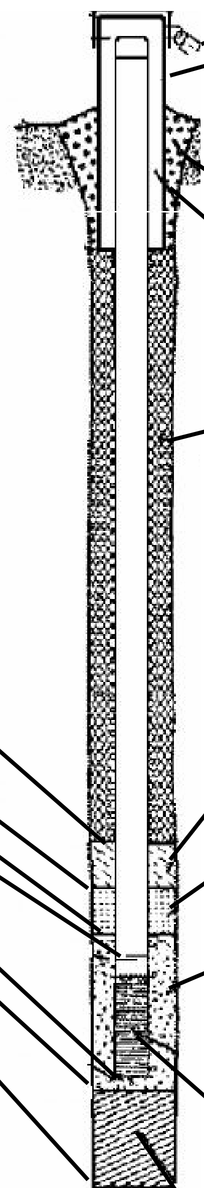
Well Driller License Number:

Geologist:

A. Protective pipe: ft. above grade
B. Well casing, top elevation: ft. MSL
C. Land Surface Elevation: ft. MSL
D. Surface seal, bottom: ft.below grade

12. USCS classification of soil near screen:
GP☐ GM ☐ GC ☐ GW ☐ SP ☐ SM ☐
SC☐ SW☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐
13. Sieve analysis attached? Yes ☐ No ☐
14. Drilling method used: Rotary ☐ HSA ☐
Other:
15. Drilling fluid used:
Water☐ Air ☐ Drilling Mud ☐None ☐
16. Drilling additives used? Yes ☐ No ☐
Specify:
17: Source of water:

E. Bentonite seal: top ft. (depth)
F. Fine sand: top ft. (depth)
G. Filter pack: top ft. (depth)
H. Screen joint top: ft. (depth)
I. Well bottom: f t. (depth)
J. Filter pack: bottom ft. (depth)
K. Borehole: bottom . ft.(depth)
Borehole diameter: in.



1. Cap and lock? ☐ Yes ☐ No
2. Protective cover pipe:
a. Inside diameter: in.
b. Length: ft.
c. Material: *Steel* ☐ *Other*
3. Surface seal: *Bentonite* ☐ *Concrete* ☐
Other:
4. Material blw. well casing and protective pipe:
Bentonite ☐ *Annular space seal* ☐
Other:
5. Annular space seal: *(Manufacturer name)*
a. Granular bentonite ☐
b. Bentonite/Cement slurry ☐
% bentonite ……. Bentonite/cement grout ☐
Lbs/gal mud weight … bentonite slurry ☐
c. How installed: *Tremie* ☐ *Tremie pumped* ☐
Gravity ☐
6. Bentonite seal: *(Manufacturer, product name)*
Bentonite granules ☐
☐ *¼ in.* ☐ *3/8 in.* ☐ *½ in. Bentonite pellets* ☐
Other:
7. Fine sand material: *(Manufacturer, product name, mesh size)*
Volume added: ft^3
8. Filter pack material: *(Manufacturer, product name, mesh size)*
Volume added: ft^3
9. Well casing: Flush-threaded Sch 40 PVC☐
Flush-threaded Sch 80 PVC☐
Other:
10. Screen material:
a. Screen type: factory cut ☐ continuous slot ☐
Other:
b. Manufacturer:
c. Slot size: 0. in.
d. Slotted length: ft.
11. Backfill material: *or* None ☐

CERTIFICATION:
I hereby certify that the information on this form is true and correct to the best of my knowledge:

(Signature)

(Company Name)

Attachment 3

Groundwater Sampling Form

ENSAFE

WELL DEVELOPMENT & GROUNDWATER SAMPLING FORM

DATE:	JOB NUMBER:	EQUIPMENT (Make/Model #/Serial #):
PROJECT:	EVENT:	/ /
WELL ID:	LOCATION:	/ /
WEATHER CONDITIONS:	AMBIENT TEMP:	/ /
REVIEWED BY:	PERSONNEL:	/ /

WELL DIA:	**WELL DEVELOPMENT**	
TOTAL DEPTH from TOC (ft.):	START:	FINISH:
DEPTH TO WATER from TOC (ft.):	VOLUME PURGED (gal):	
LENGTH OF WATER COL. (ft.):	**GROUNDWATER SAMPLING**	
1 VOLUME OF WATER (gal):	START:	FINISH:
3 VOLUMES OF WATER (gal):	VOLUME PURGED (gal):	
	ANALYSIS:	

WELL DEVELOPMENT PARAMETERS		GW SAMPLING PARAMETERS	
Temperature:	± 1.0° C	Temperature:	± 0.2° C
pH:	± 0.5 standard units	pH:	± 0.2 standard units
Specific Conductance:	± 10% of the past measurement	Specific Conductance:	± 5% of the past measurement
Turbidity:	relatively stable	DO:	≤ 20% saturation
		ORP:	± 10 millivolts
		Turbidity:	≤ 10 NTU

IN-SITU TESTING

Circle one: DEVELOPMENT SAMPLING ☐ Bailer ☐ Pump Description:

Time (hh:mm):												
pH (units):												
Conductivity (mS/cm):												
Turbidity (NTU):												
DO (mg/L): YSI 556												
DO (mg/L): YSI 550												
Temperature (C°):												
ORP (mV):												
Volume Purged (gal):												
Depth to Water (ft):												
								Well Goes Dry While Purging ☐				

SAMPLE DATA

☐ Bailer ☐ Pump Description:

Sample ID	Date (m/d/y)	Time (hh:mm)	Bottles (total to lab)	Filtered (0.45 µm)	Remarks

Purging/Sampling Device Decon Process:

COMMENTS:

Purge water placed in drum#_______________

Page __ of __

Attachment 4

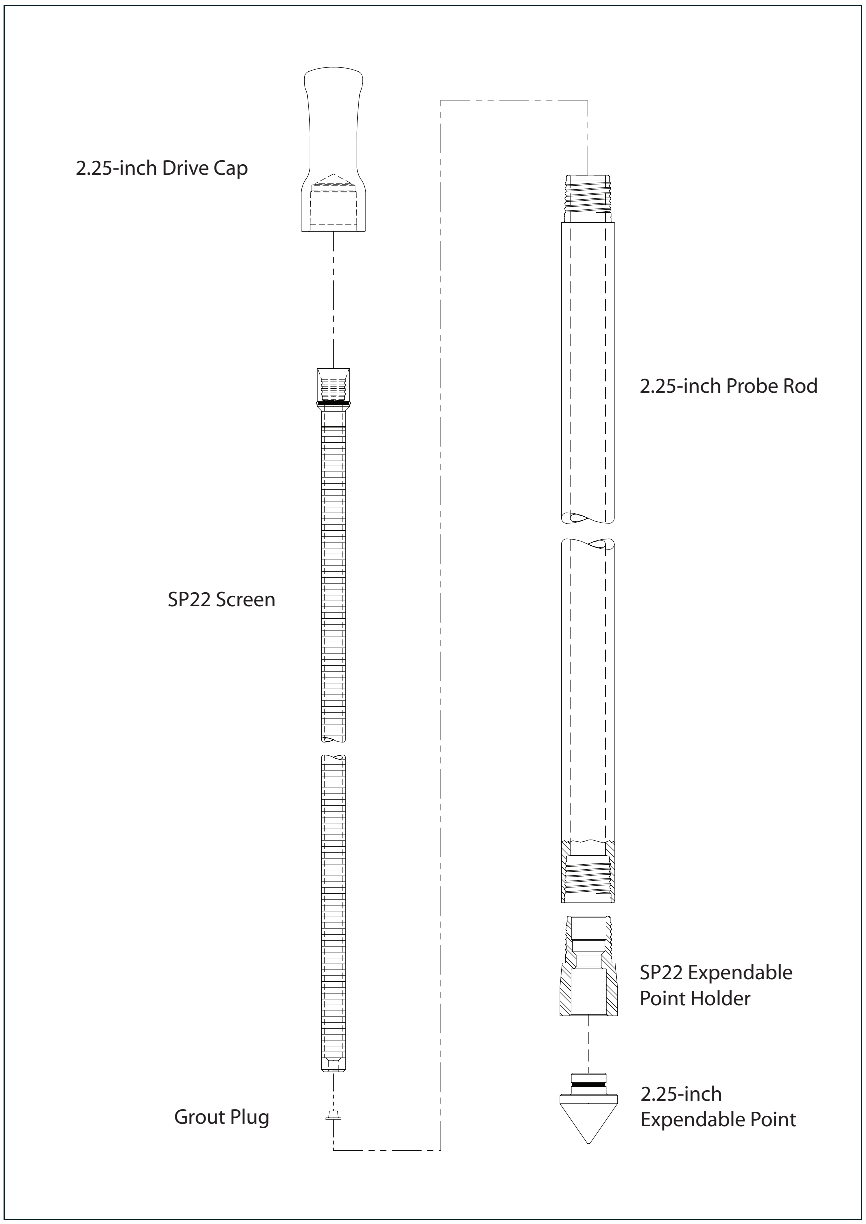
Geoprobe Screen Point 22 Groundwater Sampler

Geoprobe® Screen Point 22 Groundwater Sampler

Standard Operating Procedure

Technical Bulletin No. MK3173

PREPARED: January 2011



GEOPROBE® SCREEN POINT 22 GROUNDWATER SAMPLER PARTS

Geoprobe® and Geoprobe Systems®, Macro-Core® and Direct Image® are Registered Trademarks of Kejr, Inc., Salina, Kansas

1.0 OBJECTIVE

The objective of this procedure is to deploy a sealed stainless steel or PVC screen to depth, obtain a representative water sample from the screen interval, and grout the probe hole during abandonment. The Screen Point 22 Groundwater Sampler enables the operator to conduct abandonment grouting that meets American Society for Testing and Materials (ASTM) Method D 5299 requirements for decommissioning wells and borings for environmental activities (ASTM 1993).

2.0 BACKGROUND

2.1 Definitions

Geoprobe®: A brand name of high quality, hydraulically powered machines that utilize both static force and percussion to advance sampling and logging tools into the subsurface. The Geoprobe® brand name refers to both machines and tools manufactured by Geoprobe Systems®, Salina, Kansas. Geoprobe® tools are used to perform soil core and soil gas sampling, groundwater sampling and monitoring, soil conductivity and contaminant logging, grouting, and materials injection.

Screen Point 22 (SP22) Groundwater Sampler: A direct push device consisting of a PVC or stainless steel screen that is lowered (post-run) to depth within a sealed, steel probe rod and then deployed for the collection of representative groundwater samples. The assembled SP22 Sampler is approximately 44 inches (1118 mm) long with an OD of 1 inch (25 mm). Upon deployment, up to 41 inches (1041 mm) of screen can be exposed to the formation. There is also an optional 12-inch screen that can be used. The Screen Point 22 Groundwater Sampler is designed for use with 2.25-inch probe rods and machines equipped with the more powerful GH60 series and GH80 series Hydraulic Hammers. Operators with GH40 Series hammers may choose to use this sampler in soils where driving is easier.

Rod Grip Pull System: An attachment mounted on the hydraulic hammer of a direct push machine which makes it possible to retract the tool string with probe rods or flexible tubing protruding from the top of the probe rods. The Rod Grip Pull System includes a pull block with rod grip jaws that are bolted directly to the machine. A removable handle assembly straddles the tool string while hooking onto the pull block to effectively grip the probe rods as the hammer is raised. A separate handle assembly is required for each probe rod diameter.

2.2 Discussion (Fig. 2.1)

In this procedure, the tool string is advanced into the subsurface with a Geoprobe® direct push machine. While the tool string is advanced to depth, O-ring seals at each rod joint, the SP22 Expendable Point Holder, and the expendable drive point provide a watertight system. This system eliminates the threat of formation fluids entering the screen before deployment and assures sample integrity. (Fig. 2.1, step 1)

Once at the desired sampling interval, the SP22 sampler is attached to 1.25-inch probe rods and sent downhole until the sampler (SP22 Screen) extends through the lead 2.25-inch probe rod, contacting the expendable point. (Fig. 2.1, step 2) The tool string is then retracted approximately 41 inches (1041 mm) while the screen is held in place with the 1.25-inch probe rods. As the tool string is retracted, the expendable point is released from the SP22 Expendable Point Holder. The tool string and SP22 Expendable Point Holder may be retracted the full length of the screen or as little as a few inches if a small sampling interval is desired. (Fig 2.1, step 3)

There are two types of screens that can be used in the Screen Point 22 Groundwater Sampler. A stainless steel screen with a standard slot size of 0.004 inches (0.10 mm) and a PVC screen with a standard slot size of 0.010 inches (0.25 mm), are recovered with the tool string after sampling.

(continued on following page)

An O-ring on the head of the stainless steel screens maintains a seal at the top of the screen. As a result, any liquid entering the SP22 Expendable Point Holder during screen deployment must first pass through the screen. PVC screens do not have an O-ring, but require a PVC adapter head (page 7) which does contain an O-ring.

The screens are constructed such that flexible tubing, the SP22 Check Valve Assembly (37893), a mini-bailer, or a small-diameter bladder pump can be inserted into the screen cavity. (Fig 2.1, step 4) This makes direct sampling possible from anywhere within the saturated zone. A removable plug in the lower end of the screens allows the user to grout as the SP22 Expendable Point Holder is extracted for further use. However, an easier method is to remove the inner string of rods and the SP22 screen, and grout through the 2.25-inch probe rods. (Fig 2.1, step 5 - 6)

The SP22 Sampler can also be used with the Geoprobe® DT22 system. (Fig. 2.2)

Groundwater samples can be obtained in a number of ways. A common method utilizes polyethylene (TB25L) or Teflon® (TB25T) tubing and a Check Valve Assembly (37893). The check valve (with check ball) is attached to one end of the tubing and inserted down the casing until it is immersed in groundwater. Water is pumped through the tubing and to the ground surface by oscillating the tubing up and down.

An alternative means of collecting groundwater samples is to attach a peristaltic or vacuum pump to the tubing. This method is limited in that water can be pumped to the surface from a maximum depth of approximately 26 feet (8 m). Another technique for groundwater sampling is to use a stainless steel Mini-Bailer Assembly (GW41). The mini-bailer is lowered down the inside of the casing below the water level where it fills with water and is then retrieved from the casing.

The latest option for collecting groundwater from the SP22 Sampler is to utilize a Geoprobe® MB470 Series Mechanical Bladder Pump (MBP)*. The MBP may be used to meet requirements of the low-flow sampling protocol (Puls and Barcelona 1996, ASTM 2003). Through participation in a U.S. EPA Environmental Technology Verification study, it was confirmed that the MB470 can provide representative samples (EPA 2003).

**The Mechanical Bladder Pump is manufactured under U.S. Patent No. 6,877,965 issued April 12, 2005.*

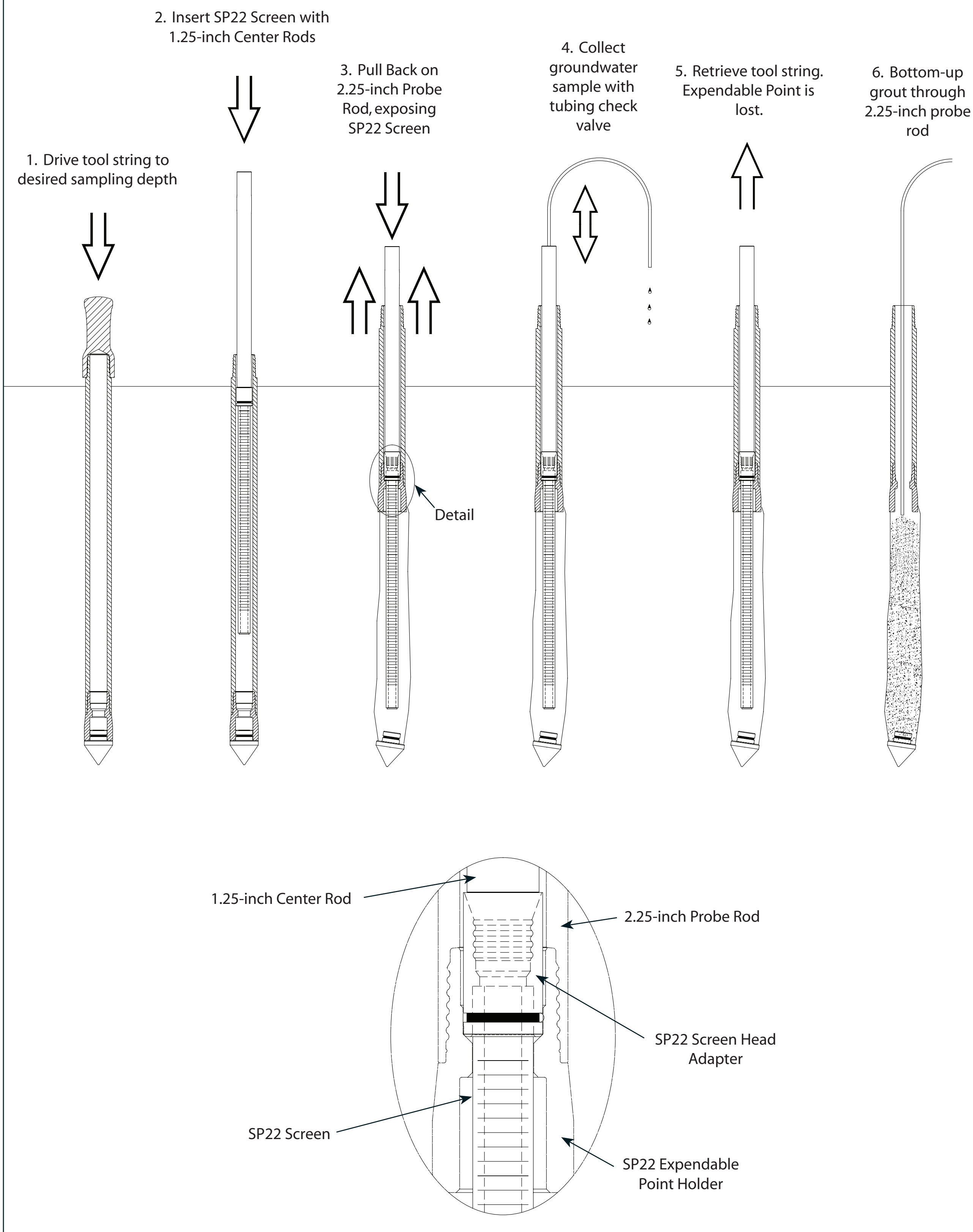


FIGURE 2.1
Screen Point 22 Groundwater Sampler

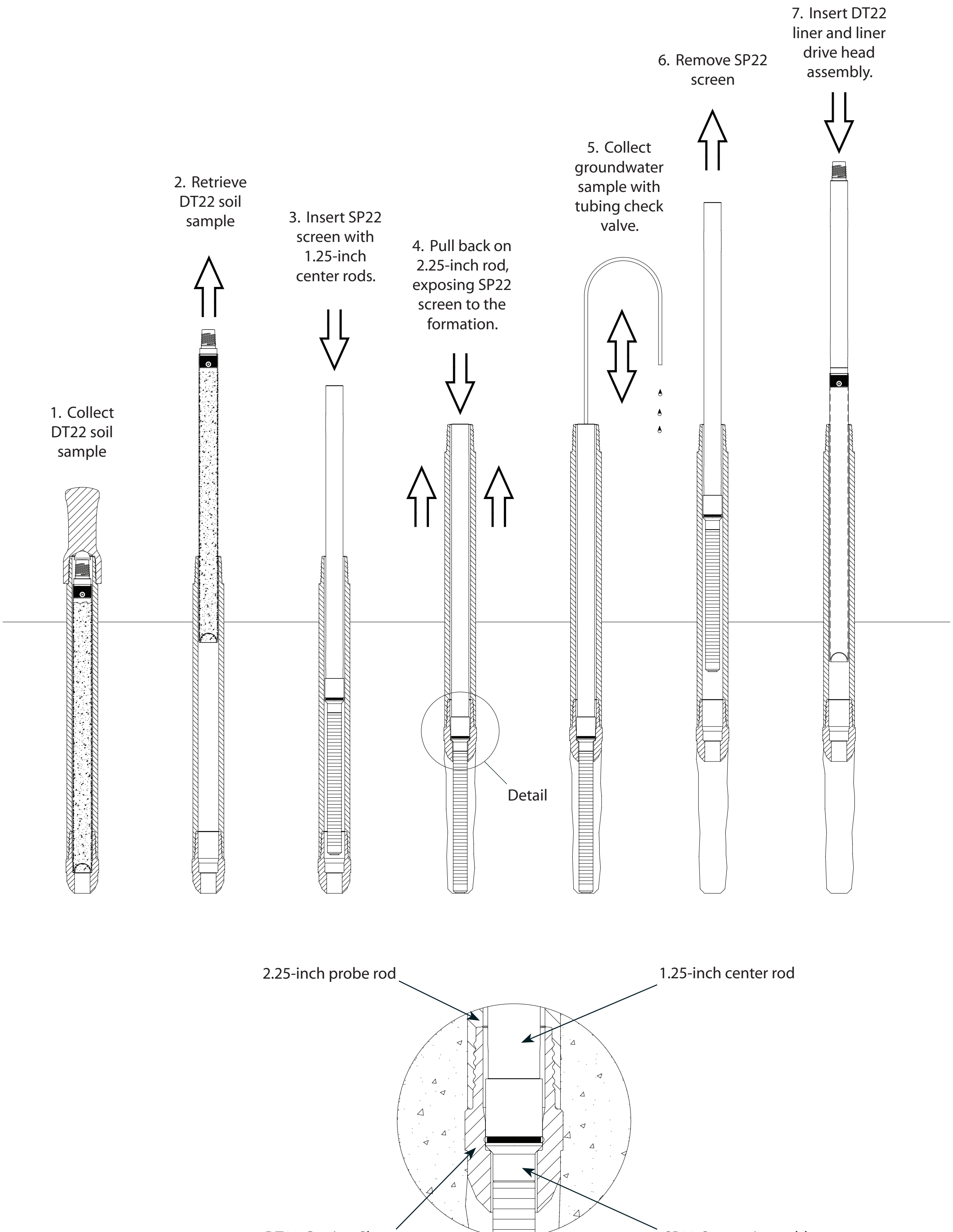


FIGURE 2.2
Screen Point 22 Groundwater Sampler Operation with DT22 Sampling System

3.0 TOOLS AND EQUIPMENT

The following tools and equipment can be used to successfully recover representative groundwater samples with the Geoprobe® Screen Point 22 Groundwater Sampler. Refer to Figures 3.1 and 3.2 for identification of the specified parts. Tools are listed below for the most common SP22 / 2.25-inch probe rod configurations. Additional parts for optional rod sizes and accessories are listed in Appendix A.

SP22 Sampler Parts	**Part Number**
SP22 PVC Screen Adapter	37865
SP22 PVC Screen Adapter	37871
SP22 PVC Screen Head	37870
SP22 Screen, Wire-Wound Stainless Steel, 4-Slot* (48-inch)	37894
SP22 Screen, Wire-Wound Stainless Steel, 4-Slot* (12-inch)	38247
SP22 Screen, PVC, .75-inch x 48-inch	38664
SP22 Screen, PVC, .75-inch x 12-inch	38667
Grout Plugs, PE (Pkg. of 25)	GW1552K
SP22 Screen Plug	38429
Expendable Drive Points, steel, 1.625-inch OD (Pkg. of 25)*	AT2015K
Expendable Drive Points, steel, extended shank	19442
SP22 Expendable Point Holder	33764

Probe Rods and Probe Rod Accessories	**Part Number**
Drive Cap, 2.25-inch probe rods, threadless, (for GH60 and GH80 Series Hammers)*	31530
Rod Grip Handle, 2.25-inch probe rods, (for GH60 and GH80 Series Hammers)*	29385
Pull Cap, 2.25-inch probe rods	33622
Probe Rod, 2.25-inch x 60-inch*	25301
Probe Rod, 2.25-inch x 48-inch	25300

Grout Accessories	**Part Number**
High-Pressure Nylon Tubing, 0.375-inch OD / 0.25-inch ID, 100-ft. (30 m)	11633
Grout Machine, auxiliary-powered*	GS2200
Grout System Accessories Package, 2.25-inch rods	GS1015

Groundwater Purging and Sampling Accessories	**Part Number**
Polyethylene Tubing, 0.375-inch OD, 500 ft.*	TB25L
Check Valve Assembly, 0.375-inch OD Tubing*	37893
Water Level Meter, 0.438-inch OD Probe, 100 ft. cable*	GW2000
Mechanical Bladder Pump**	MB470
Mini Bailer Assembly, stainless steel	GW41

* See Appendix A for additional tooling options.

** Refer to the Standard Operating Procedure (SOP) for the Mechanical Bladder Pump (Technical Bulletin No. MK3013) for additional tooling needs.

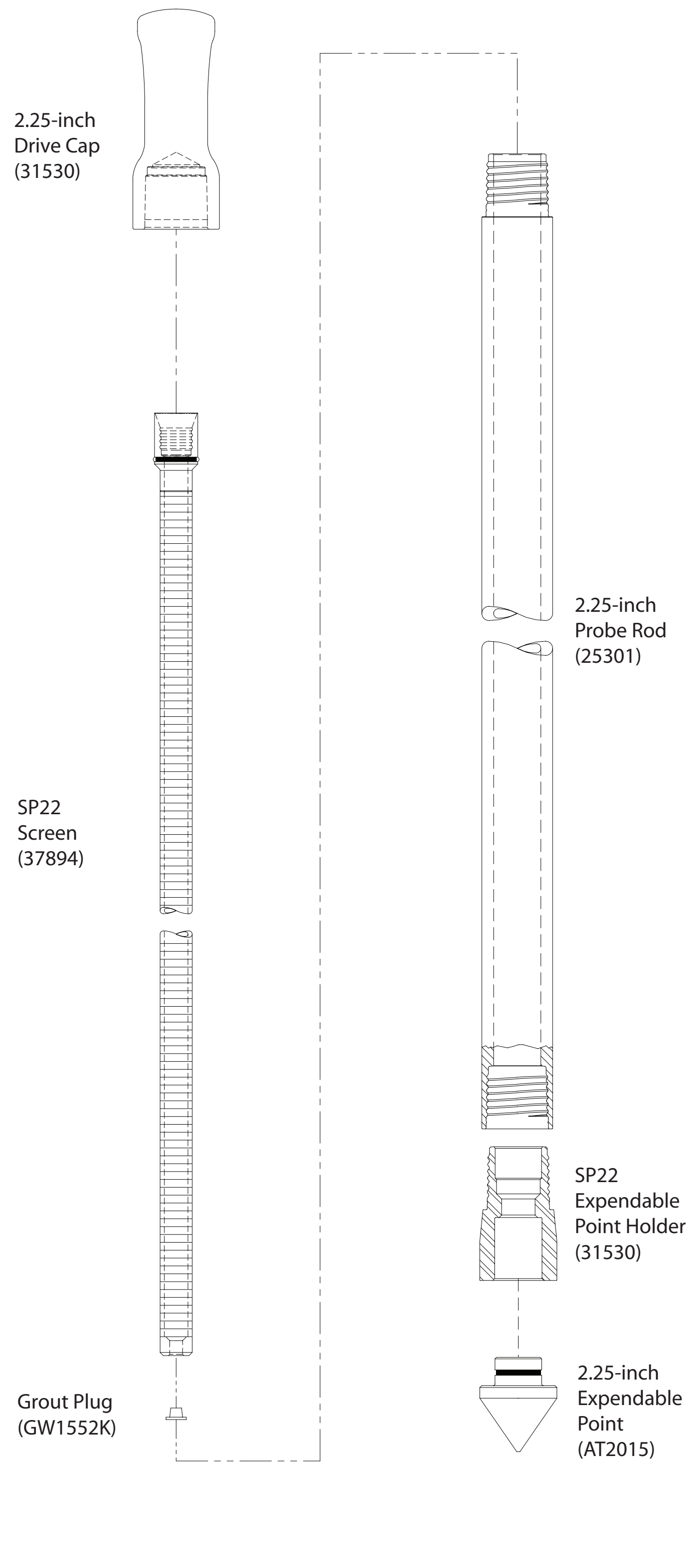


FIGURE 3.1
SP22 Sampler Parts

4.0 OPERATION

4.1 Basic Operation

The SP22 Sampler utilize a stainless steel or PVC screen which is lowered (post-run) in an alloy steel probe rod tool string. An expendable drive point is placed in the SP22 Expendable Point Holder. O-rings on the probe rods , the expendable point holder, and on an expendable point provide a watertight tool string which keeps contaminants out of the system as the sampler is driven to depth.

Once the sampling interval is reached, 1.25-inch probe rods (or 1.25-inch LWCR) rods are inserted down the ID of the 2.25-inch probe rods. The tool string is then retracted up to 41 inches (1041 mm) while the screen is held in place with the 1.25-inch probe rods (or 1.25-inch LWCR) rods. The system is now ready for groundwater sampling. When sampling is complete, a removable plug in the bottom of the screen allows for grouting below the sampler as the tool string is retrieved.

4.2 Decontamination

In order to collect representative groundwater samples, all sampler parts must be thoroughly cleaned before and after each use. Scrub all metal parts using a stiff brush and a nonphosphate soap solution. Steam cleaning may be substituted for hand-washing if available. Rinse with distilled water and allow to air-dry before assembly.

4.3 Lead Rod Assembly (Fig. 4.1)

1. Place an O-ring on the SP22 Expendable Point Holder (33764).
2. Thread SP22 Expendable Point Holder into the 2.25-inch probe rod.
3. Place an O-ring on a steel expendable drive point (AT2015K).
4. Firmly seat the expendable point in the SP22 Expendable Point Holder.
5. Place 2.25-inch Drive Cap (31530) on the top of the 2.25-inch probe rod. The lead rod assembly is now ready to be driven to depth.

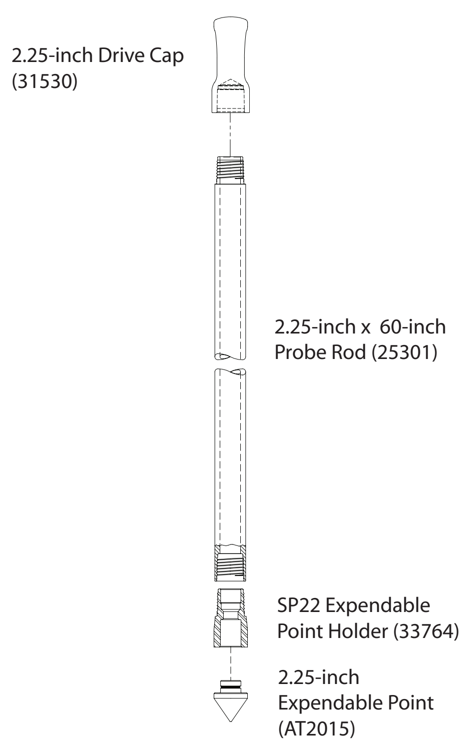


FIGURE 4.1
Lead Rod Assembly for use with the SP22 Groundwater Sampler

4.4 Advancing the Tool String (Fig. 4.2, step 1)

To provide adequate room for screen deployment with the Rod Grip Pull System, the probe derrick should be extended a little over halfway out of the carrier vehicle when positioning for operation.

1. Drive first 2.25-inch probe rod (as assembled in section 4.3).

2. Advance the tool string at a slow speed for the first few feet to ensure that the string is aligned properly.

3. Completely raise the hammer assembly. Remove the drive cap and place an O-ring in the top groove of the driven probe rod. Distilled water may be used to lubricate the O-ring if needed.

Add a probe rod (length to be determined by operator) and reattach the drive cap to the rod string. Drive the tool string the entire length of the new rod.

4. Repeat Step 3 until the desired sampling interval is reached. Approximately 12 inches (305 mm) of the last probe rod must extend above the ground surface to allow attachment of the puller assembly. A 12-inch (305 mm) rod may be added if the tool string is over-driven.

5. Remove the drive cap and retract the probe derrick away from the tool string.

4.5 Screen Deployment (Fig 4.2, step 2 - 4)

1. Thread a SP22 Stainless Steel Screen on a Lightweight Center Rod (LWCR), or 1.25-inch probe rod, and lower it into the driven casing.

2. Add LWCR's, or 1.25-inch probe rods, until the screen head contacts the bottom of the tool string.

3. Ensure that at least 48 inches (1219 mm) of 1.25-inch probe rods or LWCR's protrudes from the top 2.25-inch probe rod.

4. Maneuver the probe assembly into position for pulling.

5. Raise (pull) the tool string while physically holding the screen in place with the 1.25-inch probe rods or LWCR's . A slight knock with the 1.25-inch probe rods (or 1.25-inch LWCR's) string will help to dislodge the expendable point and start the screen moving inside the probe rod.

Raise the hammer and tool string about 41 inches (1041 mm) if using a 38664 or 37984 screen. At this point the screen head will contact the necked portion of the expendable point holder, or DT22 Cutting Shoe and the 1.25-inch probe rods (or 1.25-inch LWCR) rods will rise with the probe rods. Use care when deploying a PVC screen so as not to break the screen when it contacts the expendable point.

6. Remove the rod grip handle, lower the hammer assembly, and retract the probe derrick. Remove the top 2.25-inch probe rod.

7. Groundwater samples can now be collected with a mini-bailer, peristaltic or vacuum pump, tubing bottom check valve assembly, bladder pump, or other acceptable small diameter sampling device.

When inserting tubing or a bladder pump down the rod string, ensure that it enters the screen interval. The leading end of the tubing or bladder pump will sometimes catch at the screen head giving the illusion that the bottom of the screen has been reached. An up-and-down motion combined with rotation helps move the tubing or bladder pump past the lip and into the screen.

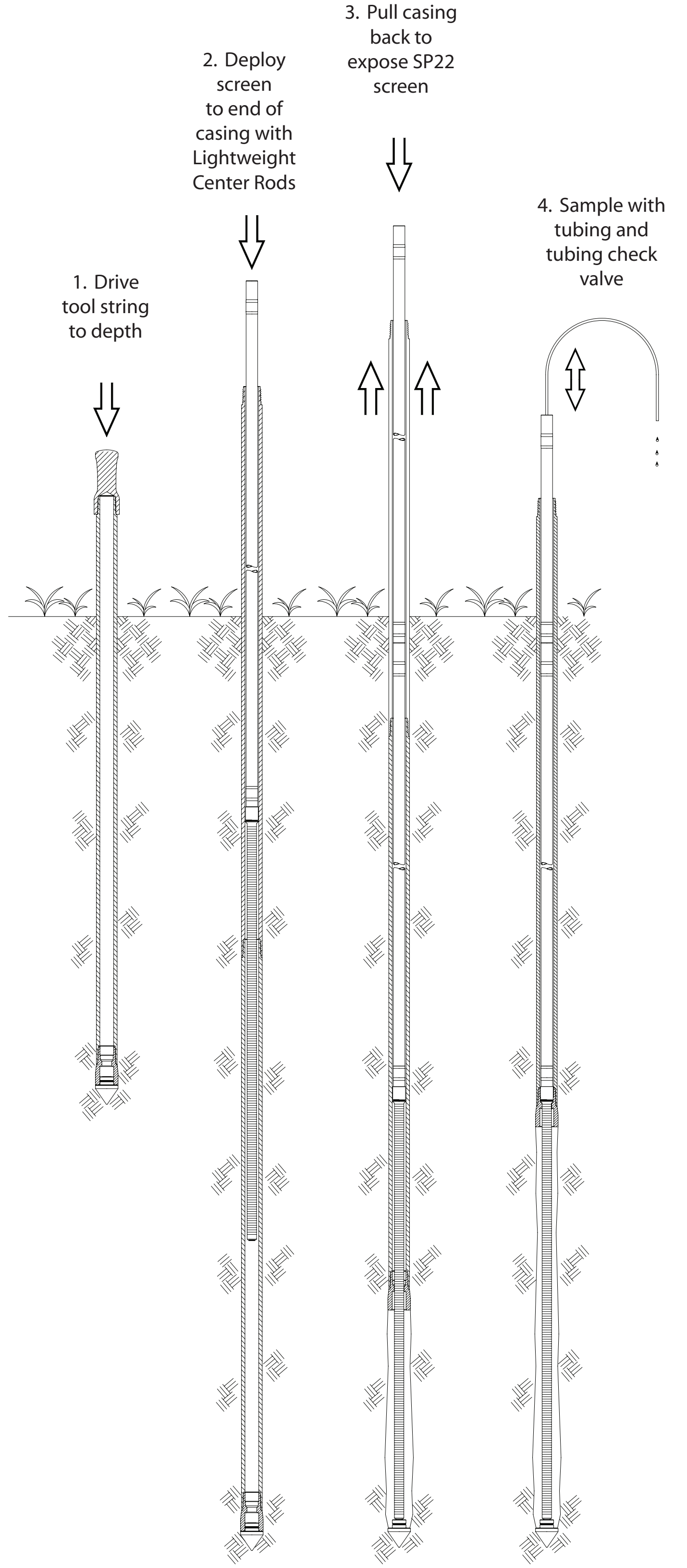


FIGURE 4.2
Screen Deployment for SP22 Sampler

4.6 Abandonment Grouting for SP22 Screens

The SP22 Sampler can meet ASTM D 5299 requirements for abandoning environmental wells or borings when grouting is conducted properly. A removable grout plug makes it possible to deploy tubing through the bottom of the SP22 screens, but the easiest method is to remove the inner string of rods; including the SP22 screen. A Grout Machine is then used to pump grout into the open probe hole as the outer casing is withdrawn. The following procedure is presented as an example only and should be modified to satisfy local abandonment grouting regulations. (Figure 4.3)

1. Maneuver the probe assembly into position for pulling.

2. High-Pressure Nylon Tubing (11633) is inserted down through the probe rods through the bottom of the SP22 expendable point holder (Fig. 4.3).

Note: *All probe rods remain strung on the tubing as the tool string is pulled. Provide extra tubing length to allow sufficient room to lay the rods on the ground as they are removed. An additional 20 feet is generally enough.*

3. Operate the grout pump while pulling the first rod with the rod grip pull system. Coordinate pumping and pulling rates so that grout fills the void left by the sampler. After pulling the first rod, release the rod grip handle, fully lower the hammer, and regrip the tool string. Unthread the top probe and slide it over the tubing placing it on the ground near the end of the tubing.

4. Repeat Step 5 until the tool string is retrieved. Do not bend or kink the tubing when pulling and laying out the probe rods. Sharp bends create weak spots in the tubing which may burst when pumping grout. Remember to operate the grout pump only when pulling the rod string. The probe hole is thus filled with grout from the bottom up as the rods are extracted.

5. Promptly clean all probe rods and sampler parts before the grout sets up and clogs the equipment.

4.7 Retrieving the Screen Point 22 Sampler

If grouting is not required, the Screen Point 22 Sampler can be retrieved by pulling the probe rods as with most other Geoprobe® applications. The Rod Grip Pull System should be used for this process as it allows the operator to remove rods without completely releasing the tool string. This avoids having the probe rods fall back downhole when released during the pulling procedure. A standard Pull Cap (33622) may still be used if preferred. Refer to the Owner's Manual for your Geoprobe® direct push machine for specific instructions on pulling the tool string.

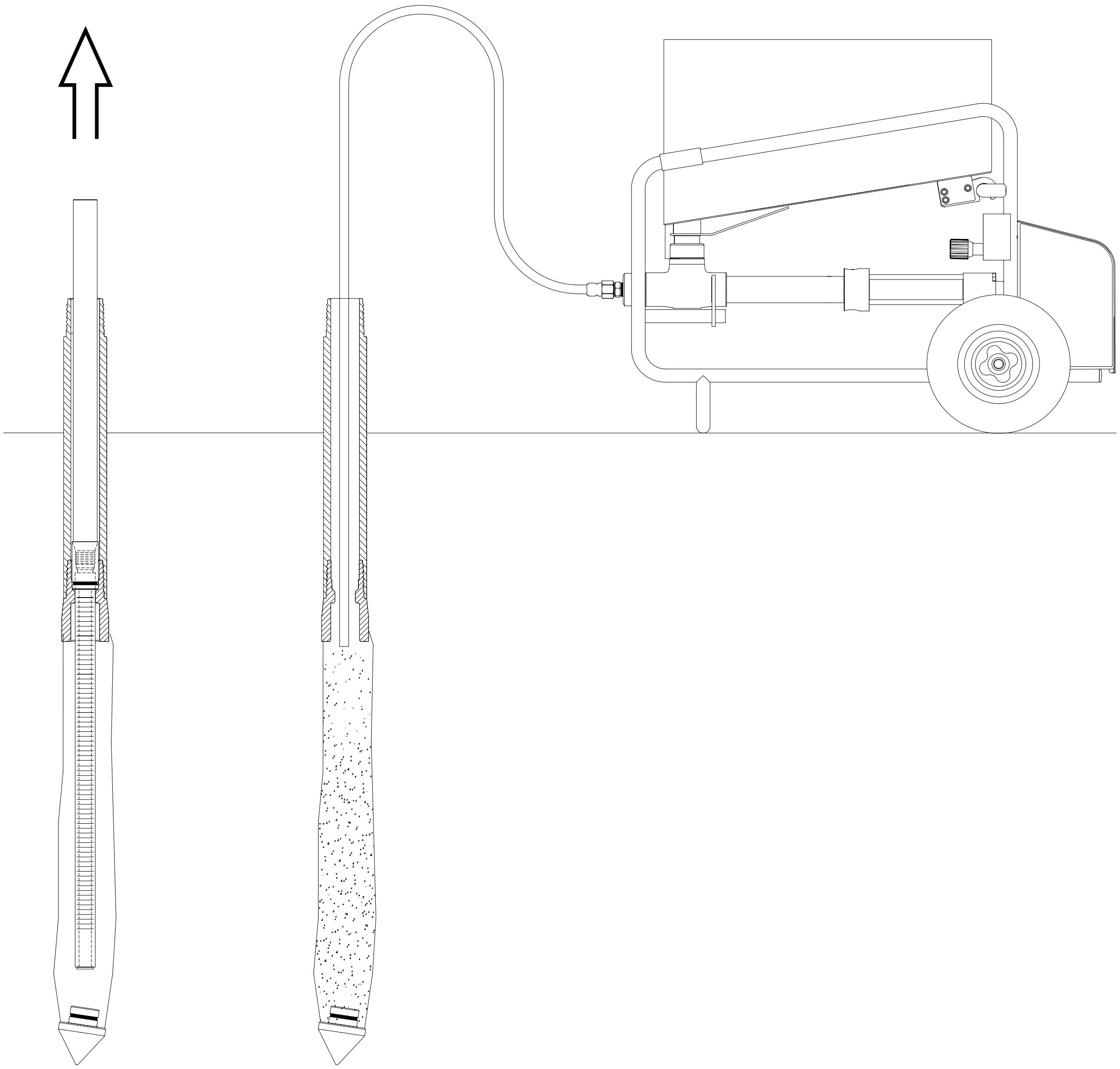


FIGURE 4.3
Abandonment Grouting for the SP22 Sampler

5.0 REFERENCES

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Appendix A
ALTERNATIVE PARTS

The following parts are available to meet unique soil conditions. See section 3.0 for a complete listing of the common tool configurations for the Geoprobe® Screen Point 22 Groundwater Sampler.

Groundwater Purging and Sampling Accessories	**Part Number**
Polyethylene Tubing, 0.25-inch OD, 500 ft.	TB17L
Polyethylene Tubing, 0.5-inch OD, 500 ft.	TB37L
Polyethylene Tubing, 0.625-inch OD, 50 ft.	TB50L
Check Valve Assembly, 0.25-inch OD Tubing	GW4240
Check Valve Assembly, 0.5-inch OD Tubing	GW4220
Check Valve Assembly, 0.625-inch OD Tubing	GW4230
Water Level Meter, 0.375-inch OD Probe, 100-ft. cable	GW2001
Water Level Meter, 0.438-inch OD Probe, 200-ft. cable	GW2002
Water Level Meter, 0.375-inch OD Probe, 200-ft. cable	GW2003
Water Level Meter, 0.438-inch OD Probe, 30-m cable	GW2005
Water Level Meter, 0.438-inch OD Probe, 60-m cable	GW2007
Water Level Meter, 0.375-inch OD Probe, 60-m cable	GW2008

Grouting Accessories	**Part Number**
Grout Nozzle, for 0.375-inch OD tubing	GW1545
Grout Machine, self-contained*	GS1000

Extension Rods and Extension Rod Accessories	**Part Number**
Screen Push Adapter	GW1535
Grout Plug Push Adapter	GW1540
Extension Rod, 60-inch*	10073
Extension Rod Coupler	AT68
Extension Rod Handle	AT69
Extension Rod Jig	AT690
Extension Rod Quick Link Coupler, pin	AT695
Extension Rod Quick Link Coupler, box	AT696

Probe Rods, Extension Rods, and Accessories	**Part Number**
Probe Rod, 2.25-inch x 1-meter	25352
Drive Cap, 2.25-inch rods (for GH40 Series Hammer)	31405
Rod Grip Pull Handle, 2.25-inch Probe Rods (for GH40 Series Hammer)	29461
Extension Rod, 48-inch	AT671
Extension Rod, 1-meter	AT675

Additional Tools	**Part Number**
Adjustable Wrench, 6.0-inch	FA200
Adjustable Wrench, 10.0-inch	FA201
Pipe Wrenches	NA

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Standard Operating Procedure SOP-3-19
Headspace Screening for VOCs

RESOLUTION CONSULTANTS

Headspace Screening for Total VOCs

Procedure 3-19

1.0 Purpose and Scope

1.1 This standard operating procedure (SOP) describes the basic techniques for using headspace analysis to screen for volatile organics in contaminated soils using a portable Photo Ionization Detector (PID) or Flame Ionization Detector (FID).

1.2 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review.

2.0 Safety

2.1 The health and safety considerations for the work associated with this SOP will be addressed in the project Health and Safety Plan (HASP). In the absence of a HASP, work will be conducted according to the Contract Task Order (CTO) Work Plan (WP) and/or direction from the **Site Safety Officer (SSO)**. Note that headspace screening usually requires Level D personal protection unless there is a potential for airborne exposure to site contaminants. Under circumstances where potential airborne exposure is possible respiratory protective equipment may be required based on personal air monitoring results. Upgrades to Level C will be coordinated with the Site Safety Officer (SSO) or **CTO Manager**.

2.2 Health and safety hazards and corresponding precautions include, but are not limited to, the following:

2.2.1 Dermal contact with contaminated soil. Personnel should treat all soil as potentially contaminated and wear chemically impervious gloves. Minimize skin contact with soil by using sampling instruments such as stainless steel spades or spoons. Do not touch any exposed skin with contaminated gloves.

2.2.2 Inhalation hazards. Appropriate air monitoring should be conducted to ensure that organic vapor concentrations in the breathing zone do not exceed action levels as specified in the Site-Specific HASP. When ambient temperatures are low enough to require warming samples using the vehicle heater, the vehicle's windows should be opened enough to prevent the build-up of any organic vapors. Use the PID or FID to verify the airborne concentrations in the vehicle remain below applicable action levels. Note that many volatile organic compounds (VOCs) are flammable and all precautions must be observed to eliminate any potential ignition sources.

2.2.3 Shipping limitations. Follow applicable regulations when shipping FID/PID equipment. When shipping an FID by air, the hydrogen tank must be bled dry. Calibration gas canisters are considered dangerous goods and must be shipped according to IATA and DOT regulations. Consult your EHS Coordinator and check with your shipping company to determine the correct shipping procedures

3.0 Terms and Definitions

None.

4.0 Interferences

4.1 Regardless of which gas is used for calibration, the instrument will respond to all analytes present in the sample that can be detected by the type of lamp used in the PID.

4.2 Moisture will generate a positive interference in the concentration measured for a PID and is characterized by a slow increase in the reading as the measurement is made. Care must be taken to minimize uptake of moisture to the extent possible. Refer to the manufacturers' instructions for care, cleaning, and maintenance.

4.3 Uptake of soil into the PID must be avoided as it will compromise instrument performance by blocking the probe, causing a positive interference, or dirtying the PID lamp. Refer to the manufacturers' instructions for care, cleaning, and maintenance.

4.4 The user should listen to the pitch of the sampling pump. Any changes in pitch may indicate a blockage and corrective action should be initiated.

5.0 Training and Qualifications

5.1 Qualifications and Training

The individual executing these procedures must have read, and be familiar with, the requirements of this SOP.

5.2 Responsibilities

5.2.1 The CTO Manager is responsible for ensuring that the collection of headspace readings comply with this procedure. The CTO Manager is responsible for ensuring that all personnel involved in the collection of headspace readings shall have the appropriate education, experience, and training to perform their assigned tasks.

5.2.2 The Program Quality Manager is responsible for ensuring overall compliance with this procedure.

5.2.3 The Field Manager is responsible for ensuring that all headspace readings are conducted according to this procedure as well as verifying that the PID/FID is in proper operating condition prior to use and for implementing the calibration.

5.2.4 All Field Personnel are responsible for the implementation of this procedure.

6.0 Equipment and Supplies

6.1 The following materials must be on hand in good operating condition and/or in sufficient quantity to ensure that proper field analysis procedures may be followed:

- Calibrated PID/FID instrument;
- Top-sealing "Zip-Loc" type plastic bags – or – 16 ounces of soil or "mason-" type glass jars and aluminum foil;
- Project field book and/or boring logs;
- Personal Protective Equipment (PPE) as specified in the project HASP; and
- Material Safety Data Sheets (MSDSs) for any chemicals or site-specific contaminants.

7.0 Procedure

7.1 Preparation

Review available project information to determine the types of organic vapors that will likely be encountered to select the right instrument. The two basic types of instruments are FIDs and PIDs.

FIDs work well with organic compounds that have relatively lightweight molecules, but may have problems detecting halogenated compounds or heavier organic compounds; FIDs can detect methane for example. Since the FID uses a flame to measure organic compounds, ensure that work is conducted in an atmosphere, which is free of combustible vapors. If ambient temperatures are below 40°F, the flame of the FID may be difficult to light.

When using a PID, select an instrument that can measure the ionization potential of the anticipated contaminants of concern. PIDs work well with a range of organic compounds and can detect some halogenated hydrocarbons; PIDs cannot detect methane. The correct ultraviolet (UV) light bulb must be selected according to the types of organic vapors that will likely be encountered. The energy of the UV light must equal or exceed the ionization potential of the organic molecules that the PID will measure. The NIOSH Pocket Guide to Chemical Hazards is one source for determining ionization potentials for different chemicals. Bulbs available for PIDs include 9.4 eV, 10.6 (or 10.2) eV, and 11.7 eV bulbs. The 10.6 eV bulb is most commonly used as it detects a fairly large range of organic molecules and does not burn out as easily as the 11.7 eV bulb. The 9.4 eV bulb is the most rugged, but detects only a limited range of compounds. Under very humid or very cold ambient conditions, the window covering the UV light may fog up, causing inaccurate readings. Ask the **SSO** about correction factors when high humidity conditions exist.

After selecting the correct instrument, calibrate the PID/FID according to the manufacturer's instructions. Record background/ambient levels of organic vapors measured on the PID/FID after calibration and make sure to subtract the background concentration (if any) from your readings. Check the PID/FID readings against the calibration standard every 20 readings or at any time when readings are suspected to be inaccurate, and recalibrate, if necessary. Be aware that, after measuring highly contaminated soil samples, the PID/FID may give artificially high readings for a time.

7.2 Top-Sealing Plastic Bag

Place a quantity of soil in a top-sealing plastic bag and seal the bag immediately. The volume of soil to be used should be determined by the **CTO Manager** or **Field Manager**. The volume of soil may vary between projects but should be consistent for all samples collected for one project. Ideally, the bag should be at least 1/10th-filled with soil and no more than half-filled with soil. Once the bag is sealed, shake the bag to distribute the soil evenly. If the soil is hard or clumpy, use your fingers to gently work the soil (through the bag) to break up the clumps. Do not use a sampling instrument or a rock hammer since this may create small holes in the plastic bag and allow organic vapors to escape. Alternatively, the sample may be broken up before it is placed in the bag. Use a permanent marker to record the following information on the outside of the bag:

- Site identification information (i.e., borehole number);
- Depth interval; and
- Time the sample was collected. For example: "SS-12, 2-4 ft, @1425".

Headspace should be allowed to develop before organic vapors are measured with a PID/FID. The amount of time required for sufficient headspace development will be determined by the project-specific sampling plan and the ambient temperature. Equilibration time should be the same for all samples to allow an accurate comparison of organic vapor levels between samples. However, adjustments to equilibration times may be necessary when there are large variations in ambient temperature from day to day. When ambient temperatures are below 32°F, headspace development should be within a heated building or vehicle. When heating samples, be sure there is adequate ventilation to prevent the build-up or organic vapors above action levels.

Following headspace development, open a small opening in the seal of the plastic bag. Insert the probe of a PID/FID and seal the bag back up around the probe as tightly as possible. Alternatively, the probe can be inserted through the bag to avoid loss of volatiles. Since PIDs and FIDs are sensitive to moisture, avoid touching the probe to the soil or any condensation that has accumulated inside of the bag. Since the PID/FID consumes organic vapors, gently agitate the soil sample during the reading to release fresh organic vapors from the sample. Erratic meter response may occur at high organic vapor concentrations or conditions of elevated headspace moisture, in which case, headspace data should be discounted. Record the highest reading on the field form or in the field notebook as described in Section 9.

7.3 **Jar and Aluminum Foil (Alternate Method)**

Half-fill a clean glass jar with the soil sample to be screened. Quickly cover the jar's opening with one to two sheets of clean aluminum foil and apply the screw cap to tightly seal the jar. Allow headspace development for at least ten minutes. Vigorously shake the jar for 15 seconds, both at the beginning and at the end of the headspace development period. Where ambient temperatures are below 32°F (0°C), headspace development should be within a heated area. When heating samples, be sure there is adequate ventilation to prevent the build-up of organic vapors above action levels.

Subsequent to headspace development, remove the jar lid and expose the foil seal. Quickly puncture the foil seal with the instrument sampling probe, to a point about one-half of the headspace depth. Exercise care to avoid uptake of water droplets or soil particulates. As an alternative, use a syringe to withdraw a headspace sample, and then inject the sample into the instrument probe or septum-fitted inlet. This method is acceptable contingent upon verification of methodology accuracy using a test gas standard. Following probe insertion through the foil seal or sample injection to probe, record the highest meter response on the field form or in the field notebook. Using foil seal/probe insertion method, maximum response should occur between two and five seconds. Erratic meter response may occur at high organic vapor concentrations or conditions of elevated headspace moisture, in which case, headspace data should be discounted.

8.0 Quality Control and Assurance

Quality Assurance/Quality Control (QA/QC) will include the collection of duplicate samples. In general, one duplicate will be collected per 20 samples. Organic vapor concentrations measured in the primary and duplicate samples should be similar within plus or minus 20 percent. The frequency of headspace duplicate collection will be determined by the project manager/task manager. The PID/FID instrument must be calibrated according to the manufacturer's instructions before beginning screening, and checked or recalibrated every 20 analyses or when readings are suspected to be inaccurate. Record ambient organic vapor levels in the field notebook and on the field form. Periodically check ambient organic vapor levels. If ambient levels have changed more than 20 percent, recalibrate the PID/FID. Make sure readings are not collected near a vehicle exhaust or downwind of a drill rig exhaust. If grossly contaminated soil is encountered, decontaminate sampling instruments between samples and/or change contaminated gloves to avoid cross contaminating less contaminated samples.

9.0 Records, Data Analysis, Calculations

9.1 All data generated (results and duplicate comparisons) will be recorded in the field notebook and/or on the field form. Any deviation from the outlined procedure will also be noted. Field conditions (ambient temperature, wind, etc.) should also be recorded in the field notebook.

9.2 Readings may be recorded in a field notebook, on a boring log, or on an appropriate form specific to the project. The form should include the following information:

- When the PID/FID was calibrated (date/time) and calibration standard used;
- Background/ambient concentrations measured after PID/FID calibration;
- Location of sample (i.e., bore-hole number);
- Depth interval of sample measured;
- Lithology of material measured; and
- PID/FID reading and units of measure.

9.3 Note that if PID/FID measurements are recorded on a boring log, it is not necessary to duplicate information in the column where the PID/FID readings are recorded (e.g., borehole number, depth interval, lithology type).

9.4 All documentation will be stored in the project files and retained following completion of the project.

10.0 Attachments or References

SOP 3-20 Operation and Calibration of a Photoionization Detector

Author	Reviewer	Revisions (Technical or Editorial)
Robert Shoemaker Senior Scientist	Chris Barr Program Quality Manager	Rev 0 – Initial Issue (May 2012)

Standard Operating Procedure SOP-3-20
Operation and Calibration of a Photoionization Detector

RESOLUTION CONSULTANTS

Operation and Calibration of a Photoionization Detector

Procedure 3-20

1.0 Purpose and Scope

1.1 **Purpose and Applicability**

1.1.1 This standard operating procedure (SOP) describes the procedures that will be followed by field staff for operation and calibration of a photoionization detector (PID). The PID is primarily used by AECOM personnel for safety and survey monitoring of ambient air, determining the presence of volatiles in soil and water, and detecting leakage of volatiles.

1.1.2 PIDs routinely used by field personnel include the Photovac Microtip, Thermoelectron 580EZ, and MiniRAE 2000. Personnel responsible for using the PID should first read and thoroughly familiarize themselves with the instrument instruction manual.

1.2 **Principle of Operation**

1.2.1 The PID is a non-specific vapor/gas detector. The unit generally consists of a hand-held probe that houses a PID, consisting of an ultraviolet (UV) lamp, two electrodes, and a small fan which pulls ambient air into the probe inlet tube. The probe is connected to a readout/control box that consists of electronic control circuits, a readout display, and the system battery. Units are available with UV lamps having an energy from 9.5 electron volts (eV) to 11.7 eV.

1.2.2 The PID analyzer measures the concentration of trace gas present in the atmosphere by photoionization. Photoionization occurs when an atom or molecule absorbs a photon of sufficient energy to release an electron and become a positive ion. This will occur when the ionization potential of the molecule (in electron volts (eV)) is less than the energy of the photon. The source of photons is an ultraviolet lamp in the probe unit. Lamps are available with energies ranging from 9.5 eV to 11.7 eV. All organic and inorganic vapor/gas compounds having ionization potentials lower than the energy output of the UV lamp are ionized and the resulting potentiometric change is seen as a positive reading on the unit. The reading is proportional to the concentration of organics and/or inorganics in the vapor.

1.2.3 Sample gases enter the probe through the inlet tube and enter the ion chamber where they are exposed to the photons emanating from the UV lamp. Ionization occurs for those molecules having ionization potentials near to or less than that of the lamp. A positive- biased polarizing electrode causes these positive ions to travel to a collector electrode in the chamber. Thus the ions create an electrical current which is amplified and displayed on the meter. This current is proportional to the concentration of trace gas present in the ion chamber and to the sensitivity of that gas to photoionization.

1.2.4 In service, the analyzer is first calibrated with a gas of known composition equal to, close to, or representative of that to be measured. Gases with ionization potentials near to or less than the energy of the lamp will be ionized. These gases will thus be detected and measured by the analyzer. Gases with ionization potentials greater than the energy of the lamp will not be detected. The ionization potentials of the major components of air, i.e., oxygen, nitrogen, and carbon dioxide, range from about 12.0 eV to 15.6 eV and are not ionized by any of the lamps available. Gases with ionization potentials near to or slightly higher than the lamp are partially ionized, with low sensitivity.

1.3 **Specifications**

1.3.1 Refer to the manufacturer's instructions for the technical specifications of the instrument being used. The operating concentration range is typically 0.1 to 2,000 ppm isobutylene equivalent.

2.0 Safety

2.1 The health and safety considerations for the work associated with this SOP, including both potential physical and chemical hazards, will be addressed in the project Health and Safety Plan (HASP). In the absence of a HASP, work will be conducted according to the Contract Task Order (CTO) Work Plan (WP) and/or direction from the **Site Safety Officer (SSO)**.

2.2 Only PIDs stamped Division I Class I may be used in explosive atmospheres. Refer to the project HASP for instructions pertaining to instrument use in explosive atmospheres.

3.0 Terms and Definitions

None.

4.0 Interferences

4.1 Regardless of which gas is used for calibration, the instrument will respond to all analytes present in the sample that can be detected by the type of lamp used in the PID.

4.2 Moisture will generate a positive interference in the concentration measured for a PID and is characterized by a slow increase in the reading as the measurement is made. Care must be taken to minimize uptake of moisture to the extent possible. Refer to the manufacturers' instructions for care, cleaning, and maintenance.

4.3 Uptake of soil into the PID must be avoided as it will compromise instrument performance by blocking the probe, causing a positive interference, or dirtying the PID lamp. Refer to the manufacturers' instructions for care, cleaning, and maintenance.

4.4 The user should listen to the pitch of the sampling pump. Any changes in pitch may indicate a blockage and corrective action should be initiated.

5.0 Training and Qualifications

5.1 **Qualifications and Training**

The individual executing these procedures must have read, and be familiar with, the requirements of this SOP.

5.2 **Responsibilities**

5.2.1 The CTO Manager is responsible for ensuring that the operation and calibration activities comply with this procedure. The CTO Manager is responsible for ensuring that all personnel involved in the operation and calibration shall have the appropriate education, experience, and training to perform their assigned tasks.

5.2.2 The Program Quality Manager is responsible for ensuring overall compliance with this procedure.

5.2.3 The Field Manager is responsible for ensuring that all operation and calibration activities are conducted according to this procedure.

5.2.4 All Field Personnel are responsible for the implementation of this procedure.

6.0 Equipment and Supplies

- Calibration Gas: Compressed gas cylinder of isobutylene in air or similar stable gas mixture of known concentration. The selected gas should have an ionization potential similar to that of the vapors to be monitored, if known. The concentration should be at 50-75% of the range in which the instrument is to be calibrated;

- Regulator for calibration gas cylinder;
- Approximately 6 inches of Teflon® tubing;
- Tedlar bag (optional);
- Commercially-supplied zero grade air (optional);
- "Magic Marker" or “Sharpie” or other waterproof marker;
- Battery charger;
- Moisture traps;
- Spare lamps;
- Manufacturer’s instructions; and
- Field data sheets or logbook/pen.

7.0 Procedure

7.1 **Preliminary Steps**

7.1.1 Preliminary steps (battery charging, check-out, calibration, maintenance) should be conducted in a controlled or non-hazardous environment.

7.2 **Calibration**

7.2.1 The PID must be calibrated in order to display concentrations in units equivalent to ppm. First a supply of zero air (ambient air or from a supplied source), containing no ionizable gases or vapors is used to set the zero point. A span gas, containing a known concentration of a photoionizable gas or vapor, is then used to set the sensitivity.

7.2.2 Calibrate the instrument according to the manufacturer’s instructions. Record the instrument model and identification number, the initial and adjusted meter readings, the calibration gas composition and concentration, and the date and the time in the field records.

7.2.3 If the calibration cannot be achieved or if the span setting resulting from calibration is 0.0, then the lamp must be cleaned (Section 7.4).

7.3 **Operation**

7.3.1 Turn on the unit and allow it to warm up (minimum of 5 minutes). Check to see if the intake fan is functioning; if so, the probe will vibrate slightly and a distinct sound will be audible when holding the probe casing next to the ear. Also, verify on the readout display that the UV lamp is lit.

7.3.2 Calibrate the instrument as described in Section 7.2, following the manufacturer’s instructions. Record the calibration information in the field records.

7.3.3 The instrument is now operational. Readings should be recorded in the field records.

7.3.4 When the PID is not being used or between monitoring intervals, the unit may be switched off to conserve battery power and UV lamp life; however, a “bump” test should be performed each time the unit is turned on and prior to taking additional measurements. To perform a bump test, connect the outlet tubing from a Tedlar bag containing a small amount of span gas to the inlet tubing on the unit and record the reading. If the reading is not within the tolerance specified in the project plan, the unit must be recalibrated.

7.3.5 At the end of each day, recheck the calibration. The check will follow the same procedures as the initial calibration (Section 7.2) except that no adjustment will be made to the instrument. Record the information in the field records.

7.3.6 Recharge the battery after each use (Section 7.4).

7.3.7 When transporting, ensure that the instrument is packed in its stored condition in order to prevent damage.

7.4 **Routine Maintenance**

7.4.1 Routine maintenance associated with the use of the PID includes charging the battery, cleaning the lamp window, replacing the detector UV lamp, replacing the inlet filter, and replacing the sample pump. Refer to the manufacturer's instructions for procedures and frequency.

7.4.2 All routine maintenance should be performed in a non-hazardous environment.

7.5 **Troubleshooting Tips**

7.5.1 One convenient method for periodically confirming instrument response is to hold the sensor probe next to the tip of a magic marker. A significant reading should readily be observed.

7.5.2 Air currents or drafts in the vicinity of the probe tip may cause fluctuations in readings.

7.5.3 A fogged or dirty lamp, due to operation in a humid or dusty environment, may cause erratic or fluctuating readings. The PID should never be operated without the moisture trap in place.

7.5.4 Moving the instrument from a cool or air-conditioned area to a warmer area may cause moisture to condense on the UV lamp and produce unstable readings.

7.5.5 A zero reading on the meter should not necessarily be interpreted as an absence of air contaminants. The detection capabilities of the PID are limited to those compounds that will be ionized by the particular probe used.

7.5.6 Many volatile compounds have a low odor threshold. A lack of meter response in the presence of odors does not necessarily indicate instrument failure.

7.5.7 When high vapor concentrations enter the ionization chamber in the PID the unit can become saturated or "flooded". Remove the unit to a fresh air environment to allow the vapors to be completely ionized and purged from the unit.

8.0 Quality Control and Assurance

8.1 The end use of the data will determine the quality assurance requirements that are necessary to produce data of acceptable quality. These quality assurance requirements will be defined in the site-specific workplan or Sampling and Analysis Plan (SAP), hereafter referred to as the project plan.

8.2 Calibration of the PID will be conducted at the frequency specified in the project plan. In the absence of project-specific guidance, calibration will be performed at the beginning of each day of sampling and will be checked at the end of the sampling day or whenever instrument operation is suspect. The PID will sample a calibration gas of known concentration. The instrument must agree with the calibration gas within ±10%. If the instrument responds outside this tolerance, it must be recalibrated.

8.3 Checks of the instrument response (Section 7.5) should be conducted periodically and documented in the field records.

9.0 Records, Data Analysis, Calculations

Safety and survey monitoring with the PID will be documented in a bound field logbook, or on standardized forms, and retained in the project files. The following information is to be recorded:

- Project name and number;
- Instrument manufacturer, model, and identification number;

- Operator's signature;
- Date and time of operation;
- Calibration gas used;
- Calibration check at beginning and end of day (meter readings before adjustment);
- Span setting after calibration adjustment;
- Meter readings (monitoring data obtained);
- Instances of erratic or questionable meter readings and corrective actions taken; and
- Instrument checks and response verifications – e.g., battery check, magic marker response (Section 7.5) or similar test.

10.0 Attachments or References

United States Environmental Protection Agency. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM). USEPA, Region 4, SESD, Enforcement and Investigations Branch, Athens, GA. November 2001.

Author	Reviewer	Revisions (Technical or Editorial)
Robert Shoemaker Senior Scientist	Chris Barr Program Quality Manager	Rev 0 – Initial Issue (May 2012)

Standard Operating Procedure SOP-MS Access
NSA Mid-South Installation Access

1.0 PURPOSE

This standard operating procedure (SOP) describes the process for acquiring access to the Southside of the Naval Support Activity (NSA) Mid-South installation. The primary purpose of the procedure is to familiarize Resolution Consultants and subcontract personnel with the security procedures that are necessary to gain access to the NSA Mid-South installation.

2.0 SCOPE

This procedure shall serve as a Contract Task Order (CTO) Manager-approved guidance and is consistent with protocol in the Uniform Federal Policy-Quality Assurance Project Plan (DoD 2005). No deviations from this procedure will be accepted without the approval CTO Manager as directed by NSA Mid-South personnel.

3.0 DEFINITIONS

None.

4.0 RESPONSIBILITIES

The CTO Manager and subcontractor personnel manager are responsible for verifying that these procedures are performed prior to arrival at the NSA Mid-South installation.

Field personnel are responsible for the implementation of this procedure.

5.0 PROCEDURE

The following procedures must be carefully reviewed and adhered to in order to gain access to the NSA Mid-South installation.

5.1 *RAPID*Gate Credential Procedure

Long-term access (> 4 weeks) will require personnel to acquire a *RAPID*Gate Credential. The *RAPID*Gate Credential enables full access to the installation and avoids the delay associated with "visitor passes" obtained from Security. It also enables the contractor to work at other Activities/Installations given appropriate authorization. Approximately 4 weeks are required to obtain a *RAPID*Gate credential; therefore, appropriate planning should be made in advance of work.

To obtain a *RAPID*Gate Credential, personnel should go to the Pat Thompson Conference Center 5700 Attu Street, Millington, TN 38054 and fill out the requested information in the *RAPID*Gate Kiosk. The enrollment process requires that the applicant provide the company code, which can be obtained from the Resolution Consultants' human resource managers or the CTO Manager.

Subcontract personnel will be responsible for obtaining their own company code and Credential from *RAPIDGate.*

Personnel will receive notification when the *RAPID*Gate Credential is ready and will obtain the badge by going to the Base Security Pass and ID office at the Navy Road gate. It is advised that personnel pick up and activate their *RAPID*Gate Credential within **2 weeks** of receiving the notice that it is ready. There will be a $30 fee for any Credential that needs to be reordered.

Two important notes:

1. Personnel will be required to show identification at the time of Credential pickup. The employee can show one form of identification from List A, or two forms of identification from List B, in Table 1 when picking up their *RAPID*Gate Credential.

2. Credential activation will require both the Credential ID (located on the back of the *RAPID*Gate Credential) and the last four digits of their Social Security Number to activate their credential through an automated phone activation system. Typically, a minimum of 24 hours are required for the badge to be activated; therefore, the soonest access can be granted is the day after badge pickup.

Table 1 **Required Forms of Identification**
List A – One Needed
• U.S. Passport (unexpired) • Permanent Resident Card or Alien Registration Receipt Card (Form I-551) • Passport (foreign unexpired), with I-551 stamp or attached Form I-94 indicating unexpired employment authorization • Employment Authorization Document that contains a photograph (Form I-766, I-688, I688A, I-688B) (Unexpired)
List B – Two Needed
• Driver's license or ID card issued by a state • ID Card issued by federal, state or local government agencies or entities • Birth certificate (Original or certified copy) issued by a state, county, municipal authority or outlying possession of the United States bearing an official seal • Certification of Birth Abroad issued by the Department of State (Form FS-545 or Form DS-1350) • U.S. Military card or draft record • Military Dependent's ID card • U.S. Coast Guard Merchant Mariner Card • Native American tribal document • Driver's license issued by a Canadian government authority • U.S. Social Security card issued by the Social Security Administration • School ID card with a photograph • Voter's registration card • U.S. Citizen ID Card (Form I-197) • ID Card for use of Resident Citizen in the United States (Form I-179) • Employment authorization document issued by DHS (other than those listed under List A) (Unexpired)

Once a *RAPID*Gate Credential is issued, personnel will be required to present their Credential to gain entry to Naval Support Activity Mid-South and must wear and display the Credential at all times while on the premises. Questions about the Naval Support Activity Mid-South *RAPID*Gate Program should be addressed info@rapidgate.com with the subject line re: *RAPID*Gate Program.

5.2 Short Term Installation Access Procedure (Visitor's Pass)

The following procedures should be used when long-term site access is not needed:

1. Personnel must prepare an employment eligibility form (Form I-9, Attachment 1) and a Base Access Application (Form 5530, Attachment 2).

2. The 5530 Form must be completed electronically in Microsoft Word format 2 weeks prior to arriving at the installation. This form must be submitted to the Resolution Consultants CTO Manager for routing to the Navy.

3. Current I-9 Forms are required to obtain a visitor pass and personnel will be required to provide acceptable documents to confirm their identity, as shown on Table 1, to the security officer.

4. It is important that the forms of identification listed on the I-9 and 5530 forms match what is brought to the installation. If there has been a name change or a driver's license has been acquired in a new state, NSA Mid-South security officers may not permit access because they cannot guarantee that they did the background check on the right person and that they have all the relevant information.

5. It is highly recommended that personnel refrain from obtaining a new driver's license after submitting the 5530 form and going to the NSA –MidSouth installation.

6. Personnel must ensure that the name listed on the I-9 and 5530 forms are spelled exactly the same as the identifications provided in Table 1. The I-9 and 5530 forms are considered official documents and should be completed carefully.

7. Personnel must bring the identification(s) listed on the I-9 form with them to the installation. Copies, facsimiles, PDFs, etc., of identification documents are not considered satisfactory by Base security.

5.3 Vehicle Passes

Each vehicle must have appropriate registration and insurance records to enter the installation and vehicle passess can be issued for a 1-year maximum period. In addition, all drivers must have a proper unexpired driver's license. Vehicle passes may be obtained at the Base Security office. Once obtained, the vehicle pass must be prominently displayed on the dashboard of the registered vehicle. For the extent of the installation visit, all names of drivers for that vehicle must be on the pass and Base Security may compare drivers listed on the vehicle pass to personnel identification for confirmation. If personnel listed on the vehicle pass do not match the driver's identification, Base Security may not grant access to the installation.

6.0 RECORDS

Personnel who do not have a *RAPID*Gate Credential are required to prepare the I-9 and 5530 forms as described in this procedure. All personnel are required to have proper identification (e.g., driver's license) that matches their *RAPID*Gate Credential or I-9 and 5530 forms with them at all times. All vehicle passes are to be placed on the dashboard for the extent of the base visit and placed in a secure location when off-base.

7.0 HEALTH AND SAFETY

None.

8.0 REFERENCES

Department of Defense, United States (DoD). 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

*RAPIDG*ate Enrollment Information: https://eform.rapidgate.com/Default.aspx

United States Citizenship and Immigration Services I-9, Employment Eligibility Verification: http://www.uscis.gov/i-9

9.0 ATTACHMENTS

Attachment 1: Employment Eligibility Verification form (I-9 Form)

Attachment 2: Base Access Application (Form 5530)

Attachment 1

Employment Eligibility Verification form (I-9 Form)

Note: The attached file is a copy.

Please obtain form from http://www.uscis.gov/i-9

Instructions for Employment Eligibility Verification

Department of Homeland Security
U.S. Citizenship and Immigration Services

Read all instructions carefully before completing this form.

Anti-Discrimination Notice. It is illegal to discriminate against any work-authorized individual in hiring, discharge, recruitment or referral for a fee, or in the employment eligibility verification (Form I-9 and E-Verify) process based on that individual's citizenship status, immigration status or national origin. Employers **CANNOT** specify which document(s) they will accept from an employee. The refusal to hire an individual because the documentation presented has a future expiration date may also constitute illegal discrimination. For more information, call the Office of Special Counsel for Immigration-Related Unfair Employment Practices (OSC) at 1-800-255-7688 (employees), 1-800-255-8155 (employers), or 1-800-237-2515 (TDD), or visit www.justice.gov/crt/about/osc.

What Is the Purpose of This Form?

Employers must complete Form I-9 to document verification of the identity and employment authorization of each new employee (both citizen and noncitizen) hired after November 6, 1986, to work in the United States. In the Commonwealth of the Northern Mariana Islands (CNMI), employers must complete Form I-9 to document verification of the identity and employment authorization of each new employee (both citizen and noncitizen) hired after November 27, 2011. Employers should have used Form I-9 CNMI between November 28, 2009 and November 27, 2011.

General Instructions

Employers are responsible for completing and retaining Form I-9. For the purpose of completing this form, the term "employer" means all employers, including those recruiters and referrers for a fee who are agricultural associations, agricultural employers, or farm labor contractors.

Form I-9 is made up of three sections. Employers may be fined if the form is not complete. Employers are responsible for retaining completed forms. Do not mail completed forms to U.S. Citizenship and Immigration Services (USCIS) or Immigration and Customs Enforcement (ICE).

Section 1. Employee Information and Attestation

Newly hired employees must complete and sign Section 1 of Form I-9 **no later than the first day of employment**. Section 1 should never be completed before the employee has accepted a job offer.

Provide the following information to complete Section 1:

Name: Provide your full legal last name, first name, and middle initial. Your last name is your family name or surname. If you have two last names or a hyphenated last name, include both names in the last name field. Your first name is your given name. Your middle initial is the first letter of your second given name, or the first letter of your middle name, if any.

Other names used: Provide all other names used, if any (including maiden name). If you have had no other legal names, write "N/A."

Address: Provide the address where you currently live, including Street Number and Name, Apartment Number (if applicable), City, State, and Zip Code. Do not provide a post office box address (P.O. Box). Only border commuters from Canada or Mexico may use an international address in this field.

Date of Birth: Provide your date of birth in the mm/dd/yyyy format. For example, January 23, 1950, should be written as 01/23/1950.

U.S. Social Security Number: Provide your 9-digit Social Security number. Providing your Social Security number is voluntary. However, if your employer participates in E-Verify, you must provide your Social Security number.

E-mail Address and Telephone Number (Optional): You may provide your e-mail address and telephone number. Department of Homeland Security (DHS) may contact you if DHS learns of a potential mismatch between the information provided and the information in DHS or Social Security Administration (SSA) records. You may write "N/A" if you choose not to provide this information.

All employees must attest in Section 1, under penalty of perjury, to their citizenship or immigration status by checking one of the following four boxes provided on the form:

1. **A citizen of the United States**
2. **A noncitizen national of the United States:** Noncitizen nationals of the United States are persons born in American Samoa, certain former citizens of the former Trust Territory of the Pacific Islands, and certain children of noncitizen nationals born abroad.
3. **A lawful permanent resident:** A lawful permanent resident is any person who is not a U.S. citizen and who resides in the United States under legally recognized and lawfully recorded permanent residence as an immigrant. The term "lawful permanent resident" includes conditional residents. If you check this box, write either your Alien Registration Number (A-Number) or USCIS Number in the field next to your selection. At this time, the USCIS Number is the same as the A-Number without the "A" prefix.
4. **An alien authorized to work:** If you are not a citizen or national of the United States or a lawful permanent resident, but are authorized to work in the United States, check this box.

   If you check this box:

   a. Record the date that your employment authorization expires, if any. Aliens whose employment authorization does not expire, such as refugees, asylees, and certain citizens of the Federated States of Micronesia, the Republic of the Marshall Islands, or Palau, may write "N/A" on this line.

   b. Next, enter your Alien Registration Number (A-Number)/USCIS Number. At this time, the USCIS Number is the same as your A-Number without the "A" prefix. If you have not received an A-Number/USCIS Number, record your Admission Number. You can find your Admission Number on Form I-94, "Arrival-Departure Record," or as directed by USCIS or U.S. Customs and Border Protection (CBP).

   (1) If you obtained your admission number from CBP in connection with your arrival in the United States, then also record information about the foreign passport you used to enter the United States (number and country of issuance).

   (2) If you obtained your admission number from USCIS *within the United States*, or you entered the United States without a foreign passport, you must write "N/A" in the Foreign Passport Number and Country of Issuance fields.

Sign your name in the "Signature of Employee" block and record the date you completed and signed Section 1. By signing and dating this form, you attest that the citizenship or immigration status you selected is correct and that you are aware that you may be imprisoned and/or fined for making false statements or using false documentation when completing this form. To fully complete this form, you must present to your employer documentation that establishes your identity and employment authorization. Choose which documents to present from the Lists of Acceptable Documents, found on the last page of this form. You must present this documentation no later than the third day after beginning employment, although you may present the required documentation before this date.

Preparer and/or Translator Certification

The Preparer and/or Translator Certification must be completed if the employee requires assistance to complete Section 1 (e.g., the employee needs the instructions or responses translated, someone other than the employee fills out the information blocks, or someone with disabilities needs additional assistance). The employee must still sign Section 1.

Minors and Certain Employees with Disabilities (Special Placement)

Parents or legal guardians assisting minors (individuals under 18) and certain employees with disabilities should review the guidelines in the *Handbook for Employers: Instructions for Completing Form I-9 (M-274)* on **www.uscis.gov/I-9Central** before completing Section 1. These individuals have special procedures for establishing identity if they cannot present an identity document for Form I-9. The special procedures include **(1)** the parent or legal guardian filling out Section 1 and writing "minor under age 18" or "special placement," whichever applies, in the employee signature block; and **(2)** the employer writing "minor under age 18" or "special placement" under List B in Section 2.

Section 2. Employer or Authorized Representative Review and Verification

Before completing Section 2, employers must ensure that Section 1 is completed properly and on time. Employers may not ask an individual to complete Section 1 before he or she has accepted a job offer.

Employers or their authorized representative must complete Section 2 by examining evidence of identity and employment authorization within 3 business days of the employee's first day of employment. For example, if an employee begins employment on Monday, the employer must complete Section 2 by Thursday of that week. However, if an employer hires an individual for less than 3 business days, Section 2 must be completed no later than the first day of employment. An employer may complete Form I-9 before the first day of employment if the employer has offered the individual a job and the individual has accepted.

Employers cannot specify which document(s) employees may present from the Lists of Acceptable Documents, found on the last page of Form I-9, to establish identity and employment authorization. Employees must present one selection from List A **OR** a combination of one selection from List B and one selection from List C. List A contains documents that show both identity and employment authorization. Some List A documents are combination documents. The employee must present combination documents together to be considered a List A document. For example, a foreign passport and a Form I-94 containing an endorsement of the alien's nonimmigrant status must be presented together to be considered a List A document. List B contains documents that show identity only, and List C contains documents that show employment authorization only. If an employee presents a List A document, he or she should **not** present a List B and List C document, and vice versa. If an employer participates in E-Verify, the List B document must include a photograph.

In the field below the Section 2 introduction, employers must enter the last name, first name and middle initial, if any, that the employee entered in Section 1. This will help to identify the pages of the form should they get separated.

Employers or their authorized representative must:

1. Physically examine each original document the employee presents to determine if it reasonably appears to be genuine and to relate to the person presenting it. The person who examines the documents must be the same person who signs Section 2. The examiner of the documents and the employee must both be physically present during the examination of the employee's documents.
2. Record the document title shown on the Lists of Acceptable Documents, issuing authority, document number and expiration date (if any) from the original document(s) the employee presents. You may write "N/A" in any unused fields.

   If the employee is a student or exchange visitor who presented a foreign passport with a Form I-94, the employer should also enter in Section 2:

   a. The student's Form I-20 or DS-2019 number (Student and Exchange Visitor Information System-SEVIS Number); **and** the program end date from Form I-20 or DS-2019.
3. Under Certification, enter the employee's first day of employment. Temporary staffing agencies may enter the first day the employee was placed in a job pool. Recruiters and recruiters for a fee do not enter the employee's first day of employment.
4. Provide the name and title of the person completing Section 2 in the Signature of Employer or Authorized Representative field.
5. Sign and date the attestation on the date Section 2 is completed.
6. Record the employer's business name and address.
7. Return the employee's documentation.

Employers may, but are not required to, photocopy the document(s) presented. If photocopies are made, they should be made for **ALL** new hires or reverifications. Photocopies must be retained and presented with Form I-9 in case of an inspection by DHS or other federal government agency. Employers must always complete Section 2 even if they photocopy an employee's document(s). Making photocopies of an employee's document(s) cannot take the place of completing Form I-9. Employers are still responsible for completing and retaining Form I-9.

Unexpired Documents

Generally, only unexpired, original documentation is acceptable. The only exception is that an employee may present a certified copy of a birth certificate. Additionally, in some instances, a document that appears to be expired may be acceptable if the expiration date shown on the face of the document has been extended, such as for individuals with temporary protected status. Refer to the *Handbook for Employers: Instructions for Completing Form I-9 (M-274)* or I-9 Central (www.uscis.gov/I-9Central) for examples.

Receipts

If an employee is unable to present a required document (or documents), the employee can present an acceptable receipt in lieu of a document from the Lists of Acceptable Documents on the last page of this form. Receipts showing that a person has applied for an initial grant of employment authorization, or for renewal of employment authorization, are not acceptable. Employers cannot accept receipts if employment will last less than 3 days. Receipts are acceptable when completing Form I-9 for a new hire or when reverification is required.

Employees must present receipts within 3 business days of their first day of employment, or in the case of reverification, by the date that reverification is required, and must present valid replacement documents within the time frames described below.

There are three types of acceptable receipts:

1. A receipt showing that the employee has applied to replace a document that was lost, stolen or damaged. The employee must present the actual document within 90 days from the date of hire.
2. The arrival portion of Form I-94/I-94A with a temporary I-551 stamp and a photograph of the individual. The employee must present the actual Permanent Resident Card (Form I-551) by the expiration date of the temporary I-551 stamp, or, if there is no expiration date, within 1 year from the date of issue.
3. The departure portion of Form I-94/I-94A with a refugee admission stamp. The employee must present an unexpired Employment Authorization Document (Form I-766) or a combination of a List B document and an unrestricted Social Security card within 90 days.

When the employee provides an acceptable receipt, the employer should:

1. Record the document title in Section 2 under the sections titled List A, List B, or List C, as applicable.
2. Write the word "receipt" and its document number in the "Document Number" field. Record the last day that the receipt is valid in the "Expiration Date" field.

By the end of the receipt validity period, the employer should:

1. Cross out the word "receipt" and any accompanying document number and expiration date.
2. Record the number and other required document information from the actual document presented.
3. Initial and date the change.

See the *Handbook for Employers: Instructions for Completing Form I-9 (M-274)* at **www.uscis.gov/I-9Central** for more information on receipts.

Section 3. Reverification and Rehires

Employers or their authorized representatives should complete Section 3 when reverifying that an employee is authorized to work. When rehiring an employee within 3 years of the date Form I-9 was originally completed, employers have the option to complete a new Form I-9 or complete Section 3. When completing Section 3 in either a reverification or rehire situation, if the employee's name has changed, record the name change in Block A.

For employees who provide an employment authorization expiration date in Section 1, employers must reverify employment authorization on or before the date provided.

Some employees may write "N/A" in the space provided for the expiration date in Section 1 if they are aliens whose employment authorization does not expire (e.g., asylees, refugees, certain citizens of the Federated States of Micronesia, the Republic of the Marshall Islands, or Palau). Reverification does not apply for such employees unless they chose to present evidence of employment authorization in Section 2 that contains an expiration date and requires reverification, such as Form I-766, Employment Authorization Document.

Reverification applies if evidence of employment authorization (List A or List C document) presented in Section 2 expires. However, employers should not reverify:

1. U.S. citizens and noncitizen nationals; or
2. Lawful permanent residents who presented a Permanent Resident Card (Form I-551) for Section 2.

Reverification does not apply to List B documents.

If both Section 1 and Section 2 indicate expiration dates triggering the reverification requirement, the employer should reverify by the earlier date.

For reverification, an employee must present unexpired documentation from either List A or List C showing he or she is still authorized to work. Employers CANNOT require the employee to present a particular document from List A or List C. The employee may choose which document to present.

To complete Section 3, employers should follow these instructions:

1. Complete Block A if an employee's name has changed at the time you complete Section 3.
2. Complete Block B with the date of rehire if you rehire an employee within 3 years of the date this form was originally completed, and the employee is still authorized to be employed on the same basis as previously indicated on this form. Also complete the "Signature of Employer or Authorized Representative" block.
3. Complete Block C if:
   - **a.** The employment authorization or employment authorization document of a current employee is about to expire and requires reverification; or
   - **b.** You rehire an employee within 3 years of the date this form was originally completed and his or her employment authorization or employment authorization document has expired. (Complete Block B for this employee as well.)

   To complete Block C:
   - **a.** Examine either a List A or List C document the employee presents that shows that the employee is currently authorized to work in the United States; and
   - **b.** Record the document title, document number, and expiration date (if any).
4. After completing block A, B or C, complete the "Signature of Employer or Authorized Representative" block, including the date.

   For reverification purposes, employers may either complete Section 3 of a new Form I-9 or Section 3 of the previously completed Form I-9. Any new pages of Form I-9 completed during reverification must be attached to the employee's original Form I-9. If you choose to complete Section 3 of a new Form I-9, you may attach just the page containing Section 3, with the employee's name entered at the top of the page, to the employee's original Form I-9. If there is a more current version of Form I-9 at the time of reverification, you must complete Section 3 of that version of the form.

What Is the Filing Fee?

There is no fee for completing Form I-9. This form is not filed with USCIS or any government agency. Form I-9 must be retained by the employer and made available for inspection by U.S. Government officials as specified in the **"USCIS Privacy Act Statement"** below.

USCIS Forms and Information

For more detailed information about completing Form I-9, employers and employees should refer to the *Handbook for Employers: Instructions for Completing Form I-9 (M-274).*

You can also obtain information about Form I-9 from the USCIS Web site at www.uscis.gov/I-9Central, by e-mailing USCIS at **I-9Central@dhs.gov**, or by calling **1-888-464-4218**. For TDD (hearing impaired), call **1-877-875-6028**.

To obtain USCIS forms or the *Handbook for Employers*, you can download them from the USCIS Web site at www.uscis.gov/forms. You may order USCIS forms by calling our toll-free number at **1-800-870-3676**. You may also obtain forms and information by contacting the USCIS National Customer Service Center at **1-800-375-5283**. For TDD (hearing impaired), call **1-800-767-1833**.

Information about E-Verify, a free and voluntary program that allows participating employers to electronically verify the employment eligibility of their newly hired employees, can be obtained from the USCIS Web site at www.dhs.gov/E-Verify, by e-mailing USCIS at **E-Verify@dhs.gov** or by calling **1-888-464-4218**. For TDD (hearing impaired), call **1-877-875-6028.**

Employees with questions about Form I-9 and/or E-Verify can reach the USCIS employee hotline by calling **1-888-897-7781**. For TDD (hearing impaired), call **1-877-875-6028.**

Photocopying and Retaining Form I-9

A blank Form I-9 may be reproduced, provided all sides are copied. The instructions and Lists of Acceptable Documents must be available to all employees completing this form. Employers must retain each employee's completed Form I-9 for as long as the individual works for the employer. Employers are required to retain the pages of the form on which the employee and employer enter data. If copies of documentation presented by the employee are made, those copies must also be kept with the form. Once the individual's employment ends, the employer must retain this form for either 3 years after the date of hire or 1 year after the date employment ended, whichever is later.

Form I-9 may be signed and retained electronically, in compliance with Department of Homeland Security regulations at 8 CFR 274a.2.

USCIS Privacy Act Statement

AUTHORITIES: The authority for collecting this information is the Immigration Reform and Control Act of 1986, Public Law 99-603 (8 USC 1324a).

PURPOSE: This information is collected by employers to comply with the requirements of the Immigration Reform and Control Act of 1986. This law requires that employers verify the identity and employment authorization of individuals they hire for employment to preclude the unlawful hiring, or recruiting or referring for a fee, of aliens who are not authorized to work in the United States.

DISCLOSURE: Submission of the information required in this form is voluntary. However, failure of the employer to ensure proper completion of this form for each employee may result in the imposition of civil or criminal penalties. In addition, employing individuals knowing that they are unauthorized to work in the United States may subject the employer to civil and/or criminal penalties.

ROUTINE USES: This information will be used by employers as a record of their basis for determining eligibility of an employee to work in the United States. The employer will keep this form and make it available for inspection by authorized officials of the Department of Homeland Security, Department of Labor, and Office of Special Counsel for Immigration-Related Unfair Employment Practices.

Paperwork Reduction Act

An agency may not conduct or sponsor an information collection and a person is not required to respond to a collection of information unless it displays a currently valid OMB control number. The public reporting burden for this collection of information is estimated at 35 minutes per response, including the time for reviewing instructions and completing and retaining the form. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to: U.S. Citizenship and Immigration Services, Regulatory Coordination Division, Office of Policy and Strategy, 20 Massachusetts Avenue NW, Washington, DC 20529-2140; OMB No. 1615-0047. **Do not mail your completed Form I-9 to this address.**

Employment Eligibility Verification

Department of Homeland Security
U.S. Citizenship and Immigration Services

USCIS
Form I-9
OMB No. 1615-0047
Expires 03/31/2016

▶START HERE. Read instructions carefully before completing this form. The instructions must be available during completion of this form.

ANTI-DISCRIMINATION NOTICE: It is illegal to discriminate against work-authorized individuals. Employers **CANNOT** specify which document(s) they will accept from an employee. The refusal to hire an individual because the documentation presented has a future expiration date may also constitute illegal discrimination.

Section 1. Employee Information and Attestation *(Employees must complete and sign Section 1 of Form I-9 no later than the **first day of employment**, but not before accepting a job offer.)*

Last Name *(Family Name)*	First Name *(Given Name)*	Middle Initial	Other Names Used *(if any)*

Address *(Street Number and Name)*	Apt. Number	City or Town	State	Zip Code

Date of Birth *(mm/dd/yyyy)*	U.S. Social Security Number	E-mail Address	Telephone Number
	- -		

I am aware that federal law provides for imprisonment and/or fines for false statements or use of false documents in connection with the completion of this form.

I attest, under penalty of perjury, that I am (check one of the following):

☐ A citizen of the United States

☐ A noncitizen national of the United States *(See instructions)*

☐ A lawful permanent resident (Alien Registration Number/USCIS Number): ____________________

☐ An alien authorized to work until (expiration date, if applicable, mm/dd/yyyy) ____________. Some aliens may write "N/A" in this field. *(See instructions)*

*For aliens authorized to work, provide your Alien Registration Number/USCIS Number **OR** Form I-94 Admission Number:*

1. Alien Registration Number/USCIS Number: ____________________

OR

2. Form I-94 Admission Number: ____________________

If you obtained your admission number from CBP in connection with your arrival in the United States, include the following:

Foreign Passport Number: ____________________

Country of Issuance: ____________________

Some aliens may write "N/A" on the Foreign Passport Number and Country of Issuance fields. (*See instructions*)

3-D Barcode
Do Not Write in This Space

Signature of Employee:	Date *(mm/dd/yyyy)*:

Preparer and/or Translator Certification *(To be completed and signed if Section 1 is prepared by a person other than the employee.)*

I attest, under penalty of perjury, that I have assisted in the completion of this form and that to the best of my knowledge the information is true and correct.

Signature of Preparer or Translator:	Date *(mm/dd/yyyy)*:

Last Name *(Family Name)*	First Name *(Given Name)*

Address *(Street Number and Name)*	City or Town	State	Zip Code

STOP ***Employer Completes Next Page*** STOP

Section 2. Employer or Authorized Representative Review and Verification

(Employers or their authorized representative must complete and sign Section 2 within 3 business days of the employee's first day of employment. You must physically examine one document from List A OR examine a combination of one document from List B and one document from List C as listed on the "Lists of Acceptable Documents" on the next page of this form. For each document you review, record the following information: document title, issuing authority, document number, and expiration date, if any.)

Employee Last Name, First Name and Middle Initial from Section 1:

List A Identity and Employment Authorization	OR	**List B** Identity	AND	**List C** Employment Authorization
Document Title:		Document Title:		Document Title:
Issuing Authority:		Issuing Authority:		Issuing Authority:
Document Number:		Document Number:		Document Number:
Expiration Date *(if any)(mm/dd/yyyy)*:		Expiration Date *(if any)(mm/dd/yyyy)*:		Expiration Date *(if any)(mm/dd/yyyy)*:
Document Title:				
Issuing Authority:				
Document Number:				
Expiration Date *(if any)(mm/dd/yyyy)*:				**3-D Barcode Do Not Write in This Space**
Document Title:				
Issuing Authority:				
Document Number:				
Expiration Date *(if any)(mm/dd/yyyy)*:				

Certification

I attest, under penalty of perjury, that (1) I have examined the document(s) presented by the above-named employee, (2) the above-listed document(s) appear to be genuine and to relate to the employee named, and (3) to the best of my knowledge the employee is authorized to work in the United States.

The employee's first day of employment *(mm/dd/yyyy)*: ________________ *(See instructions for exemptions.)*

Signature of Employer or Authorized Representative	Date *(mm/dd/yyyy)*	Title of Employer or Authorized Representative	
Last Name *(Family Name)*	First Name *(Given Name)*	Employer's Business or Organization Name	
Employer's Business or Organization Address *(Street Number and Name)*	City or Town	State	Zip Code

Section 3. Reverification and Rehires *(To be completed and signed by employer or authorized representative.)*

A. New Name *(if applicable)* Last Name *(Family Name)*	First Name *(Given Name)*	Middle Initial	**B.** Date of Rehire *(if applicable) (mm/dd/yyyy)*:

C. If employee's previous grant of employment authorization has expired, provide the information for the document from List A or List C the employee presented that establishes current employment authorization in the space provided below.

Document Title:	Document Number:	Expiration Date *(if any)(mm/dd/yyyy)*:

I attest, under penalty of perjury, that to the best of my knowledge, this employee is authorized to work in the United States, and if the employee presented document(s), the document(s) I have examined appear to be genuine and to relate to the individual.

Signature of Employer or Authorized Representative:	Date *(mm/dd/yyyy)*:	Print Name of Employer or Authorized Representative:

LISTS OF ACCEPTABLE DOCUMENTS
All documents must be UNEXPIRED

Employees may present one selection from List A or a combination of one selection from List B and one selection from List C.

LIST A **Documents that Establish Both Identity and Employment Authorization**	OR	LIST B **Documents that Establish Identity**	AND	LIST C **Documents that Establish Employment Authorization**
1. U.S. Passport or U.S. Passport Card		1. Driver's license or ID card issued by a State or outlying possession of the United States provided it contains a photograph or information such as name, date of birth, gender, height, eye color, and address		1. A Social Security Account Number card, unless the card includes one of the following restrictions: (1) NOT VALID FOR EMPLOYMENT (2) VALID FOR WORK ONLY WITH INS AUTHORIZATION (3) VALID FOR WORK ONLY WITH DHS AUTHORIZATION
2. Permanent Resident Card or Alien Registration Receipt Card (Form I-551)		2. ID card issued by federal, state or local government agencies or entities, provided it contains a photograph or information such as name, date of birth, gender, height, eye color, and address		2. Certification of Birth Abroad issued by the Department of State (Form FS-545)
3. Foreign passport that contains a temporary I-551 stamp or temporary I-551 printed notation on a machine-readable immigrant visa		3. School ID card with a photograph		3. Certification of Report of Birth issued by the Department of State (Form DS-1350)
4. Employment Authorization Document that contains a photograph (Form I-766)		4. Voter's registration card		4. Original or certified copy of birth certificate issued by a State, county, municipal authority, or territory of the United States bearing an official seal
5. For a nonimmigrant alien authorized to work for a specific employer because of his or her status: a. Foreign passport; and b. Form I-94 or Form I-94A that has the following: (1) The same name as the passport; and (2) An endorsement of the alien's nonimmigrant status as long as that period of endorsement has not yet expired and the proposed employment is not in conflict with any restrictions or limitations identified on the form.		5. U.S. Military card or draft record		5. Native American tribal document
6. Passport from the Federated States of Micronesia (FSM) or the Republic of the Marshall Islands (RMI) with Form I-94 or Form I-94A indicating nonimmigrant admission under the Compact of Free Association Between the United States and the FSM or RMI		6. Military dependent's ID card		6. U.S. Citizen ID Card (Form I-197)
		7. U.S. Coast Guard Merchant Mariner Card		7. Identification Card for Use of Resident Citizen in the United States (Form I-179)
		8. Native American tribal document		8. Employment authorization document issued by the Department of Homeland Security
		9. Driver's license issued by a Canadian government authority		
		For persons under age 18 who are unable to present a document listed above:		
		10. School record or report card		
		11. Clinic, doctor, or hospital record		
		12. Day-care or nursery school record		

Illustrations of many of these documents appear in Part 8 of the Handbook for Employers (M-274).

Refer to Section 2 of the instructions, titled "Employer or Authorized Representative Review and Verification," for more information about acceptable receipts.

Attachment 2

Base Access Application (Form 5530)

NAVSUPPACT MID-SOUTH BUILDING CAC ACCESS / ISSUE APPLICATION					
From: ENVIRONMENTAL DIVISION To: Email to MILL_BADGE@NAVY.MIL Subj: Request for Identification Badge, and access to restricted spaces					
APPLICANT INFORMATION					
Name (Last, First, Middle Initial)	Gender:	Citizenship:	SSN:		
Command/Dep. NAVFAC/PWD Mid-South	Title:		Date of Birth:		
Race:	State Drivers License#:				
Height:	Weight:	Hair Color:	Eye Color:	Work Phone:	
Company Name:	Contract Exp Date:		Contract Number:		
1. COMMAND ACCESS REQUEST					
☐ New Access	☐ Access Modification		☐ Non-CAC Contractor		
2. REASON FOR BADGE ISSUANCE					
☐ Initial Issue	☐ Renewal		☐ Replacement		
EXTERNAL BUILDING ACCESS:					
External Building(s), Days, and Time for access(EX: 455, Mon-Fri, 0600-1800)					
RESTRICTED SPACE(s) ACCESS REQUIRED:					
Building(s), Room Number, Days, Time for access(EX: 769, Room 188, 24 X 7)					
ONLY COMMAND APPOINTED AUTHORIZED PERSONNEL CAN SIGN REQUEST					
Authorizing Official: (Last Name, First and Middle Initial)			Telephone Number:		
Authorizing Official Signature: (N/A when emailed, verified by email from authorizing official)			Date:		

Privacy Act Statement

AUTHORITY: 5 U.S.C. 301; EO 12356; EO 9397

PRINCIPAL PURPOSE: To facilitate verification of a personnel security clearance for an individual applying for building access in connection with their livelihood or official duties.

ROUTINE USES; Information may be furnished to Federal, state, or local agencies for regulatory and law enforcement purposes.

DISCLOSURE: Voluntary; however, refusal to furnish requested information may result in inability to verify essential personal information and approve requested building pass application.

NAVSUPPACTMIDSOUTH 5530/7 (Rev.11-10)

Appendix D
Laboratory Accreditation Certification

CERTIFICATE OF ACCREDITATION

ANSI-ASQ National Accreditation Board/ACLASS

500 Montgomery Street, Suite 625, Alexandria, VA 22314, 877-344-3044

This is to certify that

Gulf Coast Analytical Laboratories, Inc.
7979 GSRI Avenue
Baton Rouge, LA 70820

has been assessed by ACLASS
and meets the requirements of

ISO/IEC 17025:2005 and DoD-ELAP

while demonstrating technical competence in the field(s) of

TESTING

Refer to the accompanying Scope(s) of Accreditation for information regarding the types of tests to which this accreditation applies.

ADE-1482

Certificate Number

ACLASS Approval

Certificate Valid: 08/15/2012-09/09/2014
Version No. 003 Issued: 08/29/2012

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated January 2009*).

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005 & DoD-ELAP

Gulf Coast Analytical Laboratories, Inc.

7979 GSRI Avenue, Baton Rouge, LA 70820
Karen S. Varnado Phone: 225-769-4900

TESTING

Valid to: September 9, 2014 Certificate Number: ADE- 1482

I. Environmental

MATRIX	SPECIFIC TEST or GROUP OF ANALYTES**	SPECIFICATION OR STANDARD METHOD (all EPA unless specified)	* KEY EQUIPMENT OR TECHNOLOGY USED
Water	Flashpoint / Ignitability	1010A	Automated FP Analyzer
Water	Alkalinity	SM 2320B / 310.1	Autotitrator
Water	Acidity	SM 2310B	Autotitrator
Water / Solid	Ammonia	SM 4500 NH3 B & E, 18th ed. SM 4500 NH3 B & C, 20th ed.	Autotitrator
Water	Mercury	7470A	CVAA
Solid	Mercury	7471B	CVAA
Water	Mercury	245.1 / 245.2	CVAA
Water / Solid	Cyanide	9012B	FIA
Water / Solid	Total Phenols	420.4 / 9066	FIA
Solid	Chloride	9251	FIA
Water / Solid	Chloride	9251 / 325.2 / SM 4500 Cl E	FIA
Water / Solid	Nitrate/Nitrite/N+N	353.2	FIA
Water / Solid	Total Phosphorous	365.1	FIA
Water / Solid	Reactive Cyanide	SW846 Sec 7.3	FIA
Water / Solid	Pesticides	8081A	GC-ECD
Water / Solid	PCB’s	8082A	GC-ECD
Water / Solid	Herbicides	8151A	GC-ECD

MATRIX	SPECIFIC TEST or GROUP OF ANALYTES**	SPECIFICATION OR STANDARD METHOD (all EPA unless specified)	* KEY EQUIPMENT OR TECHNOLOGY USED
Water	EDB / DBCP	8011	GC-ECD
Water / Solid	DRO / ORO	8015B	GC-FID
Water / Solid	GRO	8015B	GC-FID
Water / Solid	TPH	TX 1005 / TX 1006	GC-FID
Water / Solid	TPH	Florida PRO	GC-FID
Water / Solid	Aromatic Volatile Organics	8021B	GC-FID/PID
Water	Dissolved Gases	RSK-175	GC-FID/TCD
Water / Solid	VOCs	8260B	GC-MS
Water / Solid	SVOCs	8270C / 8270D / SIM	GC-MS
Water	VOCs	624	GC-MS
Water	SVOCs	625	GC-MS
Water / Solid	OP Pesticides	8141A	GC-NPD
Water	TSS	SM 2540D / 160.2	Gravimetric
Water	TDS	SM 2540C / 160.1	Gravimetric
Water	TS	SM 2540B / 160.3	Gravimetric
Solid	TS	SM 2540B	Gravimetric
Water / Solid	Explosives	8330A	HPLC
Water / Solid	PAH's	8310	HPLC
Water	Anions	300.0	IC
Water / Solid	Anions	9056A	IC
Water	Perchlorate	314.0	IC
Water / Solid	ICP Metals	6010B / 6010C	ICP
Water	ICP Metals	200.7	ICP
Water	Volatile Fatty Acids	GCAL SOP WL-070	Ion Chromatography
Water / Solid	Ammonia	SM 4500 NH3 B & F 18th ed	Ion Selective Electrode

500 Montgomery St. Suite 625 | Alexandria, VA 22314 | 703-836-0025 | www.aclasscorp.com

MATRIX	SPECIFIC TEST or GROUP OF ANALYTES	SPECIFICATION OR STANDARD METHOD (all EPA unless specified)	* KEY EQUIPMENT OR TECHNOLOGY USED
Water	Solid Phase Extraction	3535A	N/A
Water	Separatory Funnel Extraction	3510C	N/A
Water	Metals Digestion ICP	3010A	N/A
Solid	Ultrasonic Extraction for SVOA Analysis	3550C	N/A
Solid	Soxhlet Extraction for SVOA Analysis	3540C	N/A
Solid	Metals Digestion ICP	3050B	N/A
Water / Solid	TCLP	1311	N/A
Solid	Paint Filter Test	9095B	N/A
Water	pH	SM 4500 H+B / 9040C	pH Meter
Solid	pH	9045D	pH Meter
Water	VOC's	5030B	Purge and Trap
Solid	VOC's	5035	Purge and Trap
Water	Oil & Grease	1664A	SPE/Gravimetric
Water	Hexavalent Chromium	7196A	Spectrophotometer
Water	Sulfide	SM 4500 S2 D / 376.2	Spectrophotometer
Water	COD	HACH 8000	Spectrophotometer
Water / Solid	Sulfate	9038 / 375.4	Spectrophotometer
Water	Ortho Phosphate	SM 4500 P E	Spectrophotometer
Water	Silica	SM 4500 Si D	Spectrophotometer
Water/Solid	TKN	SM4500 Norg C SM4500 NH3 B SM4500NH3 E	Spectrophotometer
Water	Sulfide	SM 4500 S2 E / 376.1	Titration
Water / Solid	Reactive Sulfide	SW846 Sec 7.3	Titration
Solid	TOC	Lloyd Kahn 9060A	TOC Analyzer
Water	TOC	SM 5310B / 415.1 / 9060A	TOC Analyzer

MATRIX	SPECIFIC TEST or GROUP OF ANALYTES	SPECIFICATION OR STANDARD METHOD (all EPA unless specified)	* KEY EQUIPMENT OR TECHNOLOGY USED
Water	TOX	9020B	TOX Analyzer
Water	Turbidity	SM2130B	Turbidimeter
Solid	Ignitability	1030	N/A
Water	Massachusetts EPH	Massachusetts EPH	GC-FID
Solid	Massachusetts EPH	Massachusetts EPH	GC-FID
Water	Massachusetts VPH	Massachusetts VPH	GC-FID/PID
Solid	Massachusetts VPH	Massachusetts VPH	GC-FID/PID
Water/Solid	ICP-MS Metals	6020A/200.8	ICP-MS
Water	ICP-MS Metals	200.8	ICP-MS

Notes:

1. ** = As Applicable*
2. ***=Refer to accredited analyte listing for exact analyte(s) in which the lab is accredited.*
3. *This scope is part of and must be included with the Certificate of Accreditation No. ADE- 1482*

Vice President

500 Montgomery St. Suite 625 | Alexandria, VA 22314 | 703-836-0025 | www.aclasscorp.com

Accredited Analytes/Methods (by matrix)															
Gulf Coast Analytical Laboratories, Inc.															
Baton Rouge, LA															
NELAC Code	**Analyte**	**Matrix**													
		Aqueous							**Solid**						
1000	Aluminum	6010B	6010C	6020A	200.7	200.8			6010B	6010C	6020A				
1005	Antimony	6010B	6010C	6020A	200.7	200.8	3010 A	1311	6010B	6010C	6020A		1311	6010C	
1010	Arsenic	6010B	6010C	6020A	200.7	200.8	3010 A	1311	6010B	6010C	6020A		1311	6010C	
1015	Barium	6010B	6010C	6020A	200.7	200.8	3010 A	1311	6010B	6010C	6020A		1311	6010C	
1020	Beryllium	6010B	6010C	6020A	200.7	200.8	3010 A	1311	6010B	6010C	6020A		1311	6010C	
1025	Boron	6010B	6010C		200.7				6010B	6010C					
1030	Cadmium	6010B	6010C	6020A	200.7	200.8	3010 A	1311	6010B	6010C	6020A		1311	6010C	
1035	Calcium	6010B	6010C	6020A	200.7	200.8			6010B	6010C	6020A				
1040	Chromium	6010B	6010C	6020A	200.7	200.8	3010 A	1311	6010B	6010C	6020A		1311	6010C	
1045	Chromium VI	7196A													
1050	Cobalt	6010B	6010C	6020A	200.7	200.8			6010B	6010C	6020A				
1055	Copper	6010B	6010C	6020A	200.7	200.8			6010B	6010C	6020A				
1070	Iron	6010B	6010C	6020A	200.7	200.8			6010B	6010C	6020A				
1075	Lead	6010B	6010C	6020A	200.7	200.8	3010 A	1311	6010B	6010C	6020A		1311	6010C	
1085	Magnesium	6010B	6010C	6020A	200.7	200.8			6010B	6010C	6020A				
1090	Manganese	6010B	6010C	6020A	200.7	200.8			6010B	6010C	6020A				
1095	Mercury	7470A	245.2	245.1			3010 A	1311	7471B				1311	6010C	
1100	Molybdenum	6010B	6010C	6020A	200.7	200.8			6010B	6010C	6020A				
1105	Nickel	6010B	6010C	6020A	200.7	200.8			6010B	6010C	6020A				
1125	Potassium	6010B	6010C	6020A	200.7	200.8			6010B	6010C	6020A				
1140	Selenium	6010B	6010C	6020A	200.7	200.8	3010 A	1311	6010B	6010C	6020A		1311	6010C	
1150	Silver	6010B	6010C	6020A	200.7	200.8	3010 A	1311	6010B	6010C	6020A		1311	6010C	
1155	Sodium	6010B	6010C	6020A	200.7	200.8			6010B	6010C	6020A				
1160	Strontium	6010B	6010C	6020A	200.7	200.8			6010B	6010C	6020A				
1165	Thallium	6010B	6010C	6020A	200.7	200.8	3010 A	1311	6010B	6010C	6020A		1311	6010C	
1175	Tin	6010B	6010C	6020A	200.7	200.8			6010B	6010C	6020A				
1180	Titanium	6010B	6010C	6020A	200.7	200.8			6010B	6010C	6020A				
1185	Vanadium	6010B	6010C	6020A	200.7	200.8			6010B	6010C	6020A				
1190	Zinc	6010B	6010C	6020A	200.7	200.8	3010 A	1311	6010B	6010C	6020A		1311	6010C	
1192	Zirconium			6020A		200.8					6020A				
1500	Acidity(as CaCO3)	SM 2310B													
1505	Total Alkalinity(as CaCO3)	SM 2320B	EPA 310.1												
1515	Ammonia as N	SM4500 NH3 B & E	SM4500 NH3 B & F	SM4500 NH3 B & C					SM 4500 NH3 BE	SM 4500 NH3 BF	SM4500 NH3 B & C				
1540	Bromide	9056A	EPA 300.0						9056A						
1565	COD	HACH 8000													
1575	Chloride	9056A	EPA 300.0	9251	EPA 325.2			SM 4500 Cl E	9056A	9251					
1625	Corrosivity (pH)	9040C	SM 4500 H+B						9045D						
1645	Total Cyanide	9012B							9012B						
1730	Fluoride	9056A	EPA 300.0						9056A						
1755	Total Hardness (as CaCO3)	6020A	200.8												
1780	Ignitability	1010A							1010A						
1810	Nitrate as N	9056A	EPA 300.0	EPA 353.2					9056A	EPA 353.2					
1820	Nitrate and Nitrite as N	9056A	EPA 300.0	EPA 353.2					9056A	EPA 353.2					
1840	Nitrite as N	9056A	EPA 300.0	EPA 353.2					9056A	EPA 353.2					
1860	Oil & Grease	EPA 1664A													
1870	Orthophosphate as P	SM 4500 PE													
1895	Perchlorate	EPA 314.0							EPA 314.0						
1900	pH	9040C	SM 4500 H+B						9040C						
1905	Total Phenolics (4AAP)	9066	EPA 420.4						9066	EPA 420.4					
1910	Total Phosphorous	EPA 365.1							EPA 365.1						
1925	Reactive sulfide	SW846 Sec 7.3							SW846 Sec 7.3						
-	Reactive Cyanide	SW846 Sec 7.3							SW846 Sec 7.3						
-	Percent Moisture								SM 2540G						
1950	Total Solids	SM 2540B	EPA 160.3						SM2540 G						
1955	Total Dissolved Solids at 180° (TFR)	SM 2540C	EPA 160.1												
1960	Non-Filterable Residue (TSS)	SM 2540D	EPA 160.2												
2000	Sulfate	9056A	EPA 300.0	9038	EPA 375.4				9056A	9038	9038	EPA 375.4			

Accredited Analytes/Methods (by matrix)
Gulf Coast Analytical Laboratories, Inc.
Baton Rouge, LA

NELAC Code	Analyte	Matrix													
		Aqueous							Solid						
2005	Sulfide	SM 4500 S2 D	EPA 376.2	SM 4500 S2 E	EPA 376.1										
2040	TOC	SM 5310B	EPA 415.1	9060A					EPA 9060A						
2045	Total Organic Halides	9020B							9020B						
2055	Turbidity	SM 2130 B													
4315	Acetone	8260B	624						8260B						
4320	Acetonitrile	8260B	624						8260B						
4325	Acrolein	8260B	624						8260B						
4340	Acrylonitrile	8260B	624						8260B						
4375	Benzene	8260B	624	1311					8260B	1311					
4385	Bromobenzene	8260 B							8260 B						
4390	Bromochloromethane	8260B	624						8260B						
4395	Bromodichloromethane	8260B	624						8260B						
4400	Bromoform	8260B	624						8260B						
4410	2-Butanone (MEK)	8260B	624	1311					8260B	1311					
4435	n-Butylbenzene	8260B	624						8260B						
4440	sec-Butylbenzene	8260B	624						8260B						
4445	tert-Butylbenzene	8260B	624						8260B						
4450	Carbon disulfide	8260B	624						8260B						
4455	Carbon tetrachloride	8260B	624	1311					8260B	1311					
4475	Chlorobenzene	8260B	624	1311					8260B	1311					
4485	Chloroethane	8260B	624						8260B						
4500	2-Chloroethylvinylether	8260B	624						8260B						
4505	Chloroform	8260B	624	1311					8260B	1311					
4535	2-Chlorotoluene	8260B	624						8260B						
4540	4-Chlorotoluene	8260B	624						8260B						
4570	1,2-Dibromo-3-chloropropane (DBCP)	8260B	624	8011					8260B						
4575	Dibromochloromethane	8260B	624						8260B						
4585	1,2-Dibromoethane (EDB)	8260B	624	8011					8260B						
4595	Dibromomethane	8260B	624						8260B						
4610	1,2 Dichlorobenzene	8260B	624		8270C	8270D		625	8260B		8270C	8270D			
4615	1,3 Dichlorobenzene	8260B	624		8270C	8270D		625	8260B		8270C	8270D			
4620	1,4 Dichlorobenzene	8260B	624	1311	8270C	8270D		625	8260B	1311	8270C	8270D			
4625	Dichlorodifluoromethane	8260B	624						8260B						
4630	1,1-Dichloroethane	8260B	624						8260B						
4635	1,2 Dichloroethane	8260B	624	1311					8260B	1311					
4640	1,1-Dichloroethene	8260B	624	1311					8260B	1311					
4645	cis-1,2-Dichloroethene	8260B	624						8260B						
4655	1,2-Dichloropropane	8260B	624						8260B						
4660	1,3-Dichloropropane	8260B	624						8260B						
4665	2,2-Dichloropropane	8260B	624						8260B						
4670	1,1-Dichloropropene	8260B	624						8260B						
4680	cis-1,3-Dichloropropylene	8260B	624						8260B						
4685	trans-1,3-Dichloropropene	8260B	624						8260B						
4700	trans-1,2-Dichloroethene	8260B	624						8260B						
4740	p-Dioxane				8270C	8270D		625							
4765	Ethylbenzene	8260B	624						8260B						
4835	Hexachlorobutadiene	8260B	624	1311	8270C	8270D		625	8260B	1311	8270C	8270D			
4840	Hexachloroethane			1311	8270C	8270D		625		1311	8270C	8270D			
4860	2-Hexanone	8260B	624						8260B						
4900	Isopropylbenzene	8260B	624						8260B						
4910	p-Isopropyltoluene	8260B	624						8260B						
4950	Bromomethane	8260B	624						8260B						
4960	Chloromethane	8260B	624						8260B						
	Mrthyl Acetate	8260B							8260B						
4975	Methylene Chloride	8260B	624						8260B						
	Methylcyclohexane	8260B							8260B						
4995	4-Methyl-2-pentanone (MIBK)	8260B	624						8260B						

Accredited Analytes/Methods (by matrix)															
Gulf Coast Analytical Laboratories, Inc.															
Baton Rouge, LA															
NELAC Code	Analyte	Matrix													
		Aqueous							Solid						
5000	Methyl tert-butyl ether (MTBE)	8260B	624						8260B						
5005	Naphthalene	8260B	624	8310	8270 C	8270D		625	8260B		8270C	8270D			8310
5015	Nitrobenzene	8330 A		1311	8270C	8270D		625		1311	8270C	8270D		8330A	
5090	n-Propylbenzene	8260B	624						8260B						
5095	Pyridine			1311	8270C	8270D		625		1311	8270C	8270D			
5100	Styrene	8260B	624						8260B						
5105	1,1,1,2-Tetrachloroethane	8260B	624						8260B						
5110	1,1,2,2-Tetrachloroethane	8260B	624						8260B						
	1,2,4,5-Tetrachlorobenzene	8260B							8260B						
5115	Tetrachloroethene	8260B	624	1311					8260B	1311					
5140	Toluene	8260B	624						8260B						
5145	o-Toluidine				8270C	8270D		625							
	1,1,2-trichloro-1,2,2-trifluoroethane	8260B							8260B						
5150	1,2,3-Trichlorobenzene	8260B	624						8260B						
5155	1,2,4-Trichlorobenzene	8260B	624		8270C	8270D		625	8260B	8270 C	8270 D				
5160	1,1,1-Trichloroethane	8260B	624						8260B						
5165	1,1,2-Trichloroethane	8260B	624						8260B						
5170	Trichloroethene	8260B	624	1311					8260B	1311					
5175	Trichlorofluoromethane	8260B	624						8260B						
5180	1,2,3-Trichloropropane	8260B	624						8260B						
5210	1,2,4-Trimethylbenzene	8260B	624						8260B						
5215	1,3,5-Trimethylbenzene	8260B	624						8260B						
5225	Vinyl acetate	8260B	624						8260B						
5235	Vinyl chloride	8260B	624	1311					8260B	1311					
5240	m+p-Xylene	8260B	624						8260B						
5250	o-Xylene	8260B	624						8260B						
5260	Xylenes, total	8260B	624						8260B						
5500	Acenaphthene	8310			8270C	8270D		625			8270C	8270D			8310
5505	Acenaphthylene	8310			8270C	8270D		625			8270C	8270D			8310
	Acetophenone				8270C						8270C				
5545	Aniline				8270C	8270D		625			8270C	8270D			
5555	Anthracene	8310			8270C	8270D		625			8270C	8270D			8310
	Benzaldehyde				8270C						8270C				
5575	Benzo(a)anthracene	8310			8270C	8270D		625			8270C	8270D			8310
5580	Benzo(a)pyrene	8310			8270C	8270D		625			8270C	8270D			8310
5585	Benzo(b)fluoranthene	8310			8270C	8270D		625			8270C	8270D			8310
5590	Benzo(g,h,i)perylene	8310			8270C	8270D		625			8270C	8270D			8310
5595	Benzidine				8270C	8270D		625			8270C	8270D			
5600	Benzo(k)fluoranthene	8310			8270C	8270D		625			8270C	8270D			8310
5610	Benzoic acid				8270C	8270D		625			8270C	8270D			
5630	Benzyl alcohol				8270C	8270D		625			8270C	8270D			
	Biphenyl				8270C						8270C				
5660	4-Bromophenyl-phenylether				8270C	8270D		625			8270C	8270D			
5670	Butyl benzyl phthalate				8270C	8270D		625			8270C	8270D			
5680	Carbazole				8270C	8270D		625			8270C	8270D			
5700	4-Chloro-3-methylphenol				8270C	8270D		625			8270C	8270D			
5745	4-Chloroaniline				8270C	8270D		625			8270C	8270D			
5760	bis(2-Chloroethoxy)methane				8270C	8270D		625			8270C	8270D			
5765	bis(2-Chloroethyl)ether				8270C	8270D		625			8270C	8270D			
5780	bis(2-Chloroiospropyl) ether				8270C	8270D		625			8270C	8270D			
5795	2-Chloronaphthalene				8270C	8270D		625			8270C	8270D			
5800	2-Chlorophenol				8270C	8270D		625			8270C	8270D			
5825	4-Chlorophenyl-phenylether				8270C	8270D		625			8270C	8270D			
5855	Chrysene	8310			8270C	8270D		625			8270C	8270D			8310
5895	Dibenzo(a,h)anthracene	8310			8270C	8270D		625			8270C	8270D			8310
5905	Dibenzofuran				8270C	8270D		625			8270C	8270D			
5925	Di-n-butylphthalate				8270C	8270D		625			8270C	8270D			

Accredited Analytes/Methods (by matrix)
Gulf Coast Analytical Laboratories, Inc.
Baton Rouge, LA

NELAC Code	Analyte	Matrix													
		Aqueous							Solid						
5945	3,3'-Dichlorobenzidine				8270C	8270D		625			8270C	8270D			
6000	2,4-Dichlorophenol				8270C	8270D		625			8270C	8270D			
6005	2,6-Dichlorophenol				8270C	8270D		625			8270C	8270D			
6070	Diethyl phthalate				8270C	8270D		625			8270C	8270D			
6130	2,4-Dimethylphenol				8270C	8270D		625			8270C	8270D			
6135	Dimethyl phthalate				8270C	8270D		625			8270C	8270D			
6160	1,3-Dinitrobenzene	8330 A							8330A						
6175	2,4-Dinitrophenol				8270C	8270D		625			8270C	8270D			
6185	2,4-Dinitrotoluene	8330 A	1311		8270C	8270D		625		1311	8270C	8270D		8330A	
6190	2,6-Dinitrotoluene	8330 A			8270C	8270D		625			8270C	8270D		8330A	
6200	Di-n-octylphthalate				8270C	8270D		625			8270C	8270D			
6255	bis(2-ethylhexyl) phthalate				8270C	8270D		625			8270C	8270D			
6265	Fluoranthene	8310			8270C	8270D		625			8270C	8270D			8310
6270	Fluorene	8310			8270C	8270D		625			8270C	8270D			8310
6275	Hexachlorobenzene		1311		8270C	8270D		625		1311	8270C	8270D			
6285	Hexachlorocyclopentadiene				8270C	8270D		625			8270C	8270D			
6315	Indeno(1,2,3, cd)pyrene	8310			8270C	8270D		625			8270C	8270D			8310
6320	Isophorone				8270C	8270D		625			8270C	8270D			
6360	2-Methyl-4,6-Dinitrophenol				8270C	8270D		625			8270C	8270D			
6380	1-Methylnaphthalene				8270C	8270D		625							
6385	2-Methylnaphthalene	8310			8270C	8270D		625			8270C	8270D			8310
6400	2-Methylphenol		1311		8270C	8270D		625		1311	8270C	8270D			
6410	4-Methylphenol (and/or 3-Methylphenol)		1311		8270C	8270D		625		1311	8270C	8270D			
6415	Tetryl (Methyl-2,4,6-trinitrophenylnitramine)	8330 A							8330 A						
6460	2-Nitroaniline				8270C	8270D		625			8270C	8270D			
6465	3-Nitroaniline				8270C	8270D		625			8270C	8270D			
6470	4-Nitroaniline				8270C	8270D		625			8270C	8270D			
6490	2-Nitrophenol				8270C	8270D		625			8270C	8270D			
6500	4-Nitrophenol	8151 A			8270C	8270D		625	8151 A		8270C	8270D			
6525	N-Nitrosodiethylamine				8270C	8270D		625			8270C	8270D			
6530	N-Nitrosodimethylamine				8270C	8270D		625			8270C	8270D			
6535	N-Nitrosodiphenylamine				8270C	8270D		625			8270C	8270D			
6545	N-Nitroso-di-n-propylamine				8270C	8270D		625			8270C	8270D			
6590	Pentachlorobenzene				8270C	8270D		625			8270C	8270D			
6605	Pentachlorophenol	8151 A	1311		8270C	8270D		625	8151 A	1311	8270C	8270D			
6615	Phenanthrene	8310			8270C	8270D		625			8270C	8270D			8310
6625	Phenol				8270C	8270D		625			8270C	8270D			
6665	Pyrene	8310			8270C	8270D		625			8270C	8270D			8310
6715	1,2,4,5-Tetrachlorobenzene				8270C	8270D		625			8270C	8270D			
6735	2,3,4,6-Tetrachlorophenol				8270C	8270D		625			8270C	8270D			
6835	2,4,5-Trichlorophenol		1311		8270C	8270D		625		1311	8270C	8270D			
6840	2,4,6-Trichlorophenol		1311		8270C	8270D		625		1311	8270C	8270D			
6885	1,3,5-Trinitrobenzene	8330 A												8330A	
7025	Aldrin	8081B											8081B		
7075	Azinphos-methyl (Guthion)	8141B							8141B						
7105	delta-BHC	8081B											8081B		
7110	alpha-BHC	8081B											8081B		
7115	beta-BHC	8081B											8081B		
7120	gamma-BHC (Lindane)	8081B	1311							1311			8081B		
7240	alpha-Chlordane	8081B											8081B		
7245	gamma-Chlordane	8081B											8081B		
7250	Chlordane (total)	8081B											8081B		
7355	DDD (4,4)	8081B											8081B		
7360	DDE (4,4)	8081B											8081B		
7365	DDT (4,4)	8081B											8081B		
7410	Diazinon	8141B							8141B						
7470	Dieldrin	8081B											8081B		

Accredited Analytes/Methods (by matrix)															
Gulf Coast Analytical Laboratories, Inc.															
Baton Rouge, LA															
NELAC Code	Analyte	Matrix													
		Aqueous							Solid						
7510	Endosulfan I	8081B											8081B		
7515	Endosulfan II	8081B											8081B		
7520	Endosulfan sulfate	8081B											8081B		
7530	Endrin aldehyde	8081B											8081B		
7535	Endrin ketone	8081B											8081B		
7540	Endrin	8081B	1311							1311			8081B		
7685	Heptachlor	8081B	1311							1311			8081B		
7690	Heptachlor Epoxide (beta)	8081B	1311							1311			8081B		
7770	Malathion	8141B							8141B						
7775	MCPA	8151A							8151A						
7780	MCPP	8151 A							8151 A						
7810	Methoxychlor	8081B	1311							1311			8081B		
7825	Parathion, methyl	8141B							8141B						
7955	Parathion, ethyl	8141B							8141B						
7985	Phorate	8141B							8141B						
8110	Ronnel	8141B							8141B						
8200	Stirophos	8141B							8141B						
8250	Toxaphene (total)	8081B											8081B		
8505	Acifluorfen	8151 A							8151 A						
8530	Bentazon	8151 A							8151 A						
8540	Chloramben	8151 A							8151 A						
8545	2,4-D	8151 A	1311						8151A	1311					
8550	Dacthal (DCPA)	8151 A							8151 A						
8555	Dalapon	8151 A							8151 A						
8560	2,4-DB	8151 A							8151A						
8595	Dicamba	8151 A							8151A						
8600	3,5-Dichlorobenzoic acid	8151 A							8151 A						
8605	2,4-DP (Dichlorprop)	8151 A							8151 A						
8620	Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	8151 A							8151A						
8625	Disulfoton	8141B							8141B						
8645	Picloram	8151 A							8151 A						
8650	2,4,5-TP (Silvex)	8151 A	1311							1311			8151A		
8655	2,4,5-T	8151 A							8151A						
8880	Aroclor 1016	8082A							8082A						
8885	Aroclor 1221	8082A							8082A						
8890	Aroclor 1232	8082A							8082A						
8895	Aroclor 1242	8082A							8082A						
8900	Aroclor 1248	8082A							8082A						
8905	Aroclor 1254	8082A							8082A						
8910	Aroclor 1260	8082A							8082A						
9303	2-Amino-4,6-dinitrotoluene	8330 A												8330A	
9306	4-Amino-2,6-dinitrotoluene	8330 A												8330A	
9369	Diesel range organics (DRO)	8015C							8015C						
9432	RDX (Hexahydro-1,3,5-trinitro-1,3,5-triazine)	8330 A												8330A	
9507	2-Nitrotoluene	8330 A												8330A	
9510	3-Nitrotoluene	8330 A												8330A	
9513	4-Nitrotoluene	8330 A												8330A	
9522	HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine)	8330 A												8330A	
9651	2,4,6-Trinitrotoluene	8330 A												8330A	
	Methane	RSK-175													
	Ethane	RSK-175													
	Ethene	RSK-175													
	Carbon Dioxide	RSK-175													
	Lactic Acid	GCAL SOP WL-070													
	Formic Acid	GCAL SOP WL-070													
	Acetic Acid	GCAL SOP WL-070													
	Proprionic Acid	GCAL SOP WL-070													

Accredited Analytes/Methods (by matrix)															
Gulf Coast Analytical Laboratories, Inc.															
Baton Rouge, LA															
NELAC Code	**Analyte**	**Matrix**													
		Aqueous							**Solid**						
	Butyric Acid	GCAL SOP WL-070													
	1-Chlorohexane	8260B													
	1-Chlorohexane								8260B						
	1,2-Diphenylhydrazine	8270C	8270D												
	1,2-Diphenylhydrazine								8270C	8270D					
	Chlordane	8082B	1311						1311	8082B					
	Toxaphene	8082 A	1311						1311	8082 A					
	Paint Filter Test	9095B							9095B						
	Oil Range Organics	8015C							8015C						
	Petroleum Hydrocarbons	Florida PRO							Florida PRO						
	Ignitability								1030						
9408	Gasoline	8015C							8015C						
4375	Benzene	8021B							8021B						
4765	Ethyl Benzene	8021B							8021B						
5140	Toluene	8021B							8021B						
5260	Xylene	8021B							8021B						
9375	DIPE	8260B							8260B						
4770	ETBE	8260B							8260B						
5000	MTBE	8260B							8260B						
4370	TAME	8260B							8260B						
4420	tert-Butyl alcohol	8260B							8260B						
9369	Diesel	8015C							8015C						
2050	Total Petroleum Hydrocarbon	TNRCC 1005							TNRCC 1005						
	Total Petroleum Hydrocarbon	TNRCC 1006							TNRCC 1006						
	GRO-Total	TNRCC 1006							TNRCC 1006						
	DRO-Total	TNRCC 1006							TNRCC 1006						
	ORO-Total	TNRCC 1006							TNRCC 1006						
	GRO-aliphatic	TNRCC 1006							TNRCC 1006						
	DRO-alphativ	TNRCC 1006							TNRCC 1006						
	ORO-aliphatic	TNRCC 1006							TNRCC 1006						
	GRO-aromatic	TNRCC 1006							TNRCC 1006						
	DRO-aromatic	TNRCC 1006							TNRCC 1006						
	ORO-aromatic	TNRCC 1006							TNRCC 1006						
-	C5-C8 Alliphatic Hydrocarbons	MADEP VPH							MADEP VPH						
-	C9-C12 Alliphatic Hydrocarbons	MADEP VPH							MADEP VPH						
-	C9-C10 Aromatic Hydrocarbons	MADEP VPH							MADEP VPH						
-	C9-C18 Alliphatic Hydrocarbons	MADEP EPH							MADEP EPH						
-	C19-C36 Alliphatic Hydrocarbons	MADEP EPH							MADEP EPH						
-	C11-C22 Aromatic Hydrocarbons	MADEP EPH							MADEP EPH						